Engineering

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"THE ENGINEER," JANUARY 27, 1928.

With METALLURGICAL SUPPLEMENT.

The Engineer.

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VOL. CXLV.—No. 3759] LONDON: FRIDAY EVENING, JANUARY 27, 1928 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

TO BUILDERS.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Friday, 10th February, 1928, for the INSTALLATION of HEATING and HOT WATER SUPPLY APPARATUS at Sutton Telephone Exchange, Surrey.

Drawings, specification and a copy of the conditions and form of contract may be seen on application at, and bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 7565

The Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

SCHEDULE 1.—100 PAIRS of DISC WHEELS and AXLES, Metre Gauge.

SCHEDULE 2.—SEVEN SPANS of 350ft.

Tenders due on the 17th February, 1928, for No. 1, and on the 6th March, 1928, for No. 2.

Forms of Tender obtainable from the above at a fee (which will not be returned) of 5s. for each schedule. 7609

The Crown Agents for THE COLONIES, acting on behalf of the GOVERNMENT of CEYLON, invite TENDERS for the SUPPLY, INSTALLATION and MAINTENANCE of SUB-STATION PLANT and SWITCHGEAR at Colombo, Ceylon.

Copies of the specification and form of Tender can be obtained from the Crown Agents, 4, Millbank, S.W. 1, on payment of a deposit of £10 for each set, which will be returned on receipt of a bona fide Tender.

Tenders must be submitted by Noon, 24th February, 1928.

The Crown Agents do not bind themselves to accept the lowest or any Tender.

CROWN AGENTS FOR THE COLONIES.
4, Millbank, S.W. 1. 7606

An Experienced OPERATOR is REQUIRED, to Take Charge of and Work a Metal Depositing Plant at one of H.M. Royal Air Force Stations situated within 40 miles of London.

The work to be carried out will consist mainly of the salvage of components of internal combustion engines by the process of metal deposition.

Applications for this vacancy should be forwarded by post to the SECRETARY (S2), Air Ministry, Kingsway, London, W.C. 2, together with particulars of age, previous experience, and copies of references.

Wages £4 per week of 48 hours.

Applications in person will not be entertained. 7551

Assistant Engineers Re- QUIRED for the RAILWAY DEPARTMENT of NIGERIA for a tour of 12 to 18 months' service, with possible extension. Salary £480, rising to £920 a year. Outfit allowance of £60 on first appointment. Free quarters and passages, liberal leave on full salary. Candidates, aged 23 to 35, should either possess an engineering degree of a recognised University or should have passed Sections "A" and "B" of the Associate Membership Examination of the Institution of Civil Engineers. They should also have had 3 or 4 years' regular training as a Civil Engineer, preferably on Railway Works.—Apply at once by letter, stating age, particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/15394. 7605

Assistant Engineers (5) REQUIRED by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT for two tours of not less than 12 nor more than 18 months' service in the first instance. Subject to satisfactory service, the officers appointed will be eligible at the expiration of three years' service for confirmation in the permanent and pensionable establishment. Salary £480, rising to £920 a year. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, preferably between 25 and 35 years of age, must have passed the examination for A.M.I.C.E., or possess a degree in civil engineering recognised by the Institution as exempting from Parts "A" and "B" of the examination. Must have had proper technical training and preferably have had not less than two years' subsequent experience on large Engineering or Municipal Works.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/254. 7422

Research Department, WOOLWICH.

A VACANCY will shortly occur in the POST of ENGINEER-IN-CHARGE of WORKSHOPS in the Research Department, Woolwich Arsenal.

An applicant should have had a sound general education, possess a recognised degree in engineering or equivalent qualifications and have had chemical, mechanical and electrical works experience. He must be fitted to take control of fitting, machining and carpentry workshops and a drawing-office for the production of experimental machines and apparatus required for scientific laboratories, and will have the supervision and general maintenance of explosives plant and machinery and factory equipment. Salary £350, rising by annual increments of £15 to £500, together with Civil Service bonus, which at present rates brings total initial salary to approximately £485.

Annual leave with pay—28 days.

Candidates should be under 45 years of age. Ex-Service men will be preferred.

Applications to be made by letter, accompanied by copies of not more than three testimonials, to the CHIEF SUPERINTENDENT, Research Department, Woolwich, S.E. 18. 7543

The Engineer

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University College of South WALES AND MONMOUTHSHIRE.
COLEG PRIFATHROFAOL DEHEUDIR CYMRU
A MYNWY.

THE ARCHIBALD DAWNAY SCHOLARSHIP.

This Scholarship of £50 a year, tenable for three years by a student who intends to enter some branch of the Engineering Profession, will be offered for competition at the College Entrance Scholarship Examination, which begins on April 16, 1928. Further particulars and a form of application can be obtained from the undersigned, to whom the form of application must be returned on or before March 12, 1928.

D. J. A. BROWN,
Registrar.

University College, Cardiff,
January, 1928. 7544

Administrative County of LONDON.

The London County Council invites TENDERS for :
1. PIPE WORK, STEAM, FEED, &c.
2. FEED PUMP, STEAM TURBINE-DRIVEN, for the Greenwich Power Station.

The specification, drawings, form of Tender, &c., may be obtained on application to the General Manager of Tramways, Tramways Offices, Victoria Embankment, upon payment of £2 by cheque or draft to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same.

Full particulars of the work may be obtained on personal application and the contract documents may be inspected before the payment of the fee.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the Instructions for Tender and form of contract and in the "London County Council Gazette."

No Tender received by the Clerk of the Council, The County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 20th February, 1928, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
7573 Clerk of the London County Council.

PUBLIC NOTICES

Bombay, Baroda and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to 2.30 p.m. on Wednesday, 8th February, TENDERS for the SUPPLY of :—

1. METALS ;

and up to Noon on Wednesday, 8th February, TENDERS for the SUPPLY of :—

2. CHEMICALLY DRESSED WAGON COVERS, &c.
3. STEEL SLEEPER KEYS.

Tenders must be made on forms, copies of which with specification can be obtained at these offices on payment of 20s. each for No. 1 and 10s. each for Nos. 2 and 3 (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices : 91, Petty France,
Westminster, S.W. 1.
23rd January, 1928. 7574

The Guardians of the Poor of the PARISH of LAMBETH hereby invite TENDERS for the SUPPLY and ERECTION of COOKING APPARATUS at their Lambeth Hospital, at Kennington.

Printed forms of Tender (which alone will be received), with conditions annexed, together with specification, may be obtained at this office on any day except Saturday, between the hours of 10 a.m. and 5 p.m. The drawing may also be inspected upon application to the undersigned and a copy thereof can be obtained upon payment of 5s., which will be returned on the receipt of a bona fide Tender.

Tenders, which must be sealed and superscribed in accordance with the instructions set forth on the form of Tender, must be sent to the undersigned or placed in the box provided for their reception in the office of the Clerk to the Guardians, by the tenderers or their representatives, should they so desire, on or before Tuesday, the 7th February, 1928, and will be opened the following day. The Guardians do not bind themselves to accept the lowest or any Tender.

By Order,
JAMES L. GOLDSPINK,
Clerk to the Guardians.

Guardians' Board Room and Offices,
Brook-street, Kennington-road, S.E. 11,
24th January, 1928. 7580

PUBLIC NOTICES

Corporation of Doncaster. ELECTRICITY DEPARTMENT.

TENDERS are INVITED for the PURCHASE of the following superseded PLANT :—

ONE 670-kW TURBO-GENERATOR. Turbine, Willans and Robinson ; steam pressure, 200 lb. per square inch ; coupled to two Siemens direct-current generators, each of 335 kW capacity, volts 450/480 shunt, 520/550 compound, and complete with condensing plant and auxiliaries.

THREE BABCOCK and WILCOX WATER-TUBE BOILERS, evaporative capacity each 11,000 lb., working pressure 200 lb. per square inch, complete with superheaters, stokers, and all mountings.

The whole of the plant is in first-class condition and may be inspected upon application to the undersigned, from whom any further particulars can be obtained.

S. R. WINDLE,
Borough Electrical Engineer.

Electricity Offices,
Grey Friars-road, Doncaster. 7485

Metropolitan Water Board. TENDERS FOR THE SUPPLY OF CAST IRON PIPES, SLUICE VALVES AND HYDRANTS.

The Metropolitan Water Board invite TENDERS for the SUPPLY of the undermentioned STORES, &c., for periods of 6 and 12 months, commencing 1st April, 1928 :—

Tender No.
3.—Cast Iron Straight Pipes and Irregular Castings.
21.—Sluice Valves and Spindles (M.W.B. pattern), Fire Hydrants, &c.
21A.—Sluice Valves and Spindles, &c. (alternative pattern).

Tenders must be submitted on the official forms, which may be obtained from the Chief Engineer on and after Monday, 30th January, 1928, by personal application at the offices of the Board (Room 156) or upon forwarding a stamped addressed sack envelope.

Applicants should refer to the number of the Tender for which forms are required.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed in the manner indicated in the form of Tender, must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Monday, 20th February, 1928.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board.
173, Rosebery-avenue, E.C. 1,
23rd January, 1928. 7583

Metropolitan Water Board. TENDERS FOR PIPE LAYING, &c.

The Metropolitan Water Board invite TENDERS for PIPE LAYING, ALTERATIONS and BRICKLAYERS' WORK within the areas of their Kent, Northern, Southern and Western Districts for the period of twelve months, commencing 1st April, 1928.

Tenders must be submitted on the official forms, which may be obtained from the Chief Engineer on and after Monday, 30th January, 1928, by personal application at the offices of the Board (Room 156) or upon forwarding a stamped addressed sack envelope.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Pipe Laying, &c.," must be delivered to the offices of the Board (Room 122) not later than 11 a.m. on Monday, 20th February, 1928.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
23rd January, 1928. 7584

Metropolitan Water Board. TENDERS FOR SUPPLY OF PHOTO PRINTS, &c.

The Metropolitan Water Board invite TENDERS for the SUPPLY of PHOTO PRINTS, &c., for the period of twelve months, commencing 1st April, 1928.

Tenders must be submitted on the official forms, which may be obtained from the Chief Engineer on and after Monday, 30th January, 1928, by personal application at the offices of the Board (Room 156) or upon forwarding a stamped addressed sack envelope. Samples of the paper required can be seen at the offices of the Board (Room 201).

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Photo Prints, &c.," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Monday, 20th February, 1928.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
23rd January, 1928. 7585

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PUBLIC NOTICES

Poplar Board of Guardians.

TENDERS are INVITED for the SUPPLY of and INSTALLATION of a NEW WEIGHBRIDGE, including BUILDERS' WORK in connection therewith, at St. Andrew's Hospital, Bromley-by-Bow, E.3.

Persons desiring to Tender may obtain copies of the specification of the work and form of Tender from Mr. Harley Heckford, M. Inst. C.E., Architect, Council Offices, High-street, Poplar, upon depositing with him £1 1s., returnable on receipt of a bona fide Tender. Cheques to be made payable to the Clerk to the Guardians of the Parish of Poplar Borough.

Contractors will be required to pay trade union rates of wages and observe trade union conditions.

Tenders, on the prescribed form, to be delivered to the Clerk to the Guardians not later than 6 p.m. on the 8th day of February, 1928.

The Guardians do not bind themselves to accept the lowest or any Tender.

G. BUTLER,
Clerk to the Guardians.

Guardians' Offices,
45, Upper North-street, Poplar, E. 14. 7576

South Indian Railway Company,

LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

PAINTS and DRYSALTERIES.

Specification and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Paints and Drysalteries," must be left with the undersigned not later than Twelve Noon on Friday, the 10th February, 1928.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of the specification.

A. MUIRHEAD,
Managing Director.

91, Petty France, Westminster, S.W. 1,
27th January, 1928. 7613

DIESEL ENGINES FOR SALE.

Tenders are Invited for the

PURCHASE of ONE 4-CYLINDER, AIR INJECTION, FOUR-CYCLE, SULZER DIESEL ENGINE, direct coupled to 200-volt D.C. dynamo, 140 r.p.m.

Also ONE 3-CYLINDER SET as above.

These are giving an output of 400 and 300 kW respectively, and may be seen running in London by appointment. They are being removed to make room for larger sets, and will be shut down on 1st March. They must be cleared by 1st April.

Apply to the CHIEF ENGINEER, The Charing Cross Electricity Supply Co., Ltd., 60, St. Martin's-lane, W.C. 2. 7460

The South Indian Railway Company, LIMITED.

APPLICATIONS are INVITED from duly qualified candidates for the APPOINTMENT of ASSISTANT MECHANICAL ENGINEER on the Company's staff in India.

Candidates, who should preferably be not above 25 years of age and unmarried, must have received a sound general and technical education, with full practical training in Railway Locomotive Works or Locomotive Manufacturers' Workshops. They must also have had Locomotive Running Shed and Firing experience.

The salary of the appointment, which in the first instance will be for three years under agreement, will commence at Rupees 450 per mensem (inclusive of Rupees 150 overseas pay), rising by annual increments of Rupees 50 per mensem to Rupees 550 per mensem, inclusive, for the third year, and in the event of extended service to a maximum of Rupees 800 per mensem, inclusive.

A first-class passage to India will be provided by the Company, as also, subject to the terms of the agreement, a free passage home in the event of the termination of the service at or before the end of three years. If the employment is extended beyond five years the employee will become eligible for certain free passage concessions for himself and family.

Salary will commence on the date of embarkation to India.

The successful candidate will be entitled to the benefits of the Railway Provident Institution.

Forms upon which application must be made may be obtained on written application to Messrs. ROBERT WHITE and PARTNERS, 3, Victoria-street, London, S.W. 1, the Consulting Engineers to the Company. 7592

FOR SALE.
WORKSHOPS IN SOUTHERN INDIA.

The South Indian Railway

having constructed new Locomotive and Carriage Workshops at Trichinopoly, offer their WORKSHOPS at Negapatam FOR SALE as a GOING CONCERN.

Negapatam is a port on the east coast, about 200 miles south of Madras.

The Workshops cover an area of about 20 acres and are provided with sidings from the railway and connected by sidings with the port, at which the Company land their coal and timber.

The Shops are served by a Steam Generating Electric Power-house, equipped with Three Babcock and Wilcox Boilers and Three Bellies and Morcom 236 H.P. Engines direct coupled to Compound-wound Dynamos of Siemens manufacture, 640 amps., 250 volts D.C., with Switchboards, Spares, &c., complete.

There is a large range of permanent brick buildings suitable for a factory, with offices, stores buildings, also a number of iron sheds, &c.

The shops are equipped with wells and tanks and a service of water pipes.

Included in the sale, if desired, are about 500 D.C. motors of 5 to 50 B.H.P., and lathes and drilling machines, planing, slotting, screwing and woodworking machinery, steam hammer, saws, &c., a foundry with 2 couplers with a pug mill.

The shops are equipped with travelling overhead cranes, stationary jib cranes and portable steam cranes.

Five thousand men skilled in all branches of locomotive engineering and carriage and wagon building have been employed in these shops and a certain amount of this labour would be available.

The works are for sale as a whole, but offers for part or parts of the works or plant will be considered.

Full particulars with a plan of the shops and site will be supplied on application to the AGENT, South Indian Railway, Trichinopoly, Madras Presidency, Southern India.

P. ROTHERA,
Agent,
7488 South Indian Railway Company.

Wanted, an Engineer for Small

Waterworks Pumping Station, comprising Oil Engines and Deep Well Pumps. Applicant must have served apprenticeship in an engineering shop and be competent to do all running repairs to plant, mains and valves, also service laying and inspection of consumers' fittings. Preference given to man with Board of Trade Certificate. House and assistant provided.—Apply, stating age, experience, and wages required, with copies of testimonials, to SECRETARY, Water Company, Uckfield, Sussex. 7559

Mersey Docks and Harbour BOARD.

ENGINEER-IN-CHIEF.

The Mersey Docks and Harbour Board invite APPLICATIONS for the POSITION of ENGINEER-IN-CHIEF to the Board, which will be vacant at the end of June.

Candidates, who should be under 50 years of age, must be Members of the Institution of Civil Engineers and have had good experience in Dock and Harbour Construction and Maintenance and also in Estuary and River Training Works.

Applications, stating salary required, age, qualifications and experience, accompanied by copies of not more than three recent testimonials, to be sent to the undersigned not later than March 31st, 1928.

L. A. P. WARNER,
General Manager and Secretary.

Dock Office, Liverpool,
January 9th, 1928. 7454

PUBLIC NOTICES

Auckland Harbour Board.

TENDERS are INVITED for the SUPPLY and DELIVERY of TWO 3-TON COAL and CARGO ELECTRIC CRANES. Tenders close Auckland, 27th March, 1928. Copies of specification and forms of Tender may be obtained on payment of One Guinea from the Board's Agents, C. R. BUTTERS and CO., 96, Charterhouse Chambers, London, E.C. 1. 7596

City of Bradford.

WATERWORKS DEPARTMENT.

APPLICATIONS are INVITED by the Water Committee of the Bradford City Council for the APPOINTMENT of DEPUTY WATERWORKS ENGINEER.

Applicants must be Members of the Institution of Civil Engineers and must have had experience in the designing and constructing of reservoir embankments and in the administrating and management of a waterworks undertaking.

The salary attached to the post will be £1000 per annum.

The successful candidate will be required to devote his whole time to the duties of the office and to reside within the City.

The appointment will be subject to the provisions of the Local Government and other Officers Superannuation Act, 1922, and the successful applicant will be required to pass a medical examination.

Applications, stating age and the date on which the duties can be commenced, accompanied by copies of three recent testimonials (which will not be returned), and endorsed "Deputy Waterworks Engineer," must be delivered to me not later than 10 a.m. on Saturday, 3rd March next.

Canvassing members of the Council, either directly or indirectly, will be a disqualification.

N. L. FLEMING,
Town Clerk.

Town Hall, Bradford, 10th January, 1928. 7470

City of Leicester.

WATER DEPARTMENT.
PUMPING STATION ENGINEER.

The Water Committee are prepared to receive APPLICATIONS for the POST of PUMPING STATION ENGINEER at a commencing salary of £250 per annum.

The selected candidate will be required to pass a medical examination and to contribute to the fund established under the Local Government and other Officers Superannuation Act, 1922.

Candidates must not be more than 40 years of age, must have had experience in the maintenance of steam plant, preferably triple-expansion engines, be able to carry out running repairs and take charge of all labour both inside the pumping station and outside in connection with slow sand filtration.

Applications, giving full particulars of experience, present and previous appointments, age and present salary, accompanied by three recent testimonials, to be received by me not later than 14th February, 1928.

Canvassing members of the Committee will disqualify applicants.

G. T. EDWARDS, M. Inst. C.E.,
7554 Engineer and Manager.

Civil Engineer for Ferro Con-

CRETE WORK.—APPLICATIONS are INVITED (by letter only) from properly qualified candidates for immediate APPOINTMENT to the above POST in Malaya. Applicants must have received a good general and technical education, and have passed the examination for A.M. Inst. C.E. or possess a degree from a recognised engineering college, and be well experienced in large concrete work. Previous experience in a tropical climate is an advantage, but not essential. Age preferably 28-35 years. Salary £800 to £900 per annum.

Selected candidates for the above posts will only be appointed subject to passing strict medical examination.

Agreement for about two years and free first-class passage out to Malaya and home again on satisfactory termination of service.

Applicants must forward details of their career, giving particulars of education (general and technical), practical training and subsequent experience, and names of employers, appointments held and dates of such employment, together with copies only of testimonials, &c., to the undersigned, as soon as possible, but not later than February 3rd, 1928.

RENDEL, PALMER & TRITTON,
Appointments Department,
7589 13, Dartmouth-street, Westminster, S.W. 1.

CIVIL SERVICE COMMISSION.

POSITIONS VACANT—OVERSEER, FOREMAN.

The Civil Service Commis-

SIONERS invite APPLICATIONS for the following permanent pensionable POSTS in the Department of Posts and Telegraphs Factory :—

OVERSEER.—Salary £250, rising by £10 per annum to £350 per annum, plus cost-of-living bonus. Age limits 28 to 50 years. Essential qualifications :—Factory training ; technical training in general engineering subjects ; experience in workshop methods and control of men ; ability to prepare estimates.

TWO FOREMEN : (1) Telegraph and Telephone Apparatus ; (2) Machine Shop. Salary £150, rising by £7 10s. per annum to £240 per annum, plus cost-of-living bonus. Previous experience essential. Age limits 26 to 50 years.

The present bonus is £88 16s. on £150 and £119 2s. on £250. Latest date for receiving applications 7th February, 1928. Application forms and particulars may be obtained from the SECRETARY, Civil Service Commission, 33, St. Stephen's Green, Dublin, C. 2.

W.H. Co.
3/8.3221. 7567

City of Norwich.

ELECTRICITY DEPARTMENT.

FOR SALE, THREE BABCOCK and WILCOX DRUM MARINE TYPE BOILERS, each evaporating 27,000 lb. per hour at 180 lb. pressure and 100 to 150 deg. F. superheat. Two fitted with B. and W. chain-grate stokers and one for oil burning.

BABCOCK and WILCOX OIL-BURNING APPARATUS with Duplicate Steam-driven Pumps, Heaters, &c.

The boilers are insured with the Manchester Steam Users' Association, and are in first-class condition.

For further particulars apply to the CITY ELECTRICAL ENGINEER, Duke-street, Norwich. 7517

The City of Worcester Elec-

TRICITY DEPARTMENT have FOR SALE TWO BELLISS and MORCOM TRIPLE-EXPANSION ENGINE-ALTERNATORS. Engine 640 B.H.P., steam 180 lbs. per sq. in. Alternators 400 kW, two-phase, 2100 volts, 50 periods.

For further particulars apply to
C. M. SHAW, M.I.E.E.,
City Electrical Engineer,
Worcester. 7599

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

HANS RENOLD, Ltd., THANK all APPLICANTS for positions as Engineer-Salesmen for South Wales and Glasgow districts, and wish to state that the VACANCIES HAVE BEEN FILLED. 7557 A

WANTED for Abroad, a Capable REFRIGERATION ENGINEER, about 30 ; excellent prospects.—Address, 7548, The Engineer Office. 7548 A

COMBUSTION ENGINEER WANTED to Control Lancashire and water-tube boiler-house evaporating 160,000 lb. hourly ; coal consumption 225 tons weekly ; to be capable of Coal and Boiler Tests, Keeping Records and to provide efficient and economical results. Salary £250 per annum.—Age and experience to WOLSEY, Ltd., Engineering Dept., Abbey Park-road, Leicester. 7566 A

CONSTRUCTIONAL STEEL WORK DESIGNER REQUIRED in London, experienced in Steel-frame Buildings and Theatres. State experience, age, salary required.—Address, 7604, The Engineer Office. 7604 A

SITUATIONS OPEN (continued)

CEYLON FIRM of GENERAL ENGINEERS REQUIRE First-class ENGINEER DRAUGHTSMAN, DESIGNER and ESTIMATOR, 25/28, single, to Take Charge of Drawing-office employing native draughtsmen. Applicants must be regularly trained engineers with indentures and technical qualifications. Experience in Constructional Ironwork Design, Machine Design and Millwrights' Work essential ; knowledge of Building Construction an advantage. Candidates must be able to execute and direct the preparation of complete designs, details, estimates, specifications with connected correspondence and, when necessary, overlook erection. Agreement for 4 years, passage, salary Rs. 500, rising to Rs. 650, six months' leave on half-pay provided new agreement entered into. Apply, on foolscap, giving fullest particulars of experience since leaving school, with respective dates, also names of schools and night schools attended, with schedule of successes gained, copies of testimonials and reference complete. Applicants must state definitely that they are single.—Address, 7607, The Engineer Office. 7607 A

DESIGNER, Thoroughly Experienced in Refrigerating Machinery and Air Compressors, REQUIRED by Manufacturing Engineers contemplating this line of manufacture.

Applications will be treated in strict confidence. Address, 7602, The Engineer Office. 7602 A

ENGINEER MANAGER WANTED for Shipbuilding and Engineering Works in Hong Kong, with good general and technical knowledge ; must have had previous experience in Management of Marine Engine Works ; age 32-35. State experience in full and send copy testimonials.—Address, 7547, The Engineer Office. 7547 A

ENGINEER REQUIRED, with Sound Theoretical training, preferably a University Graduate, age about 35, and must have practical experience in Drawing Office and Factory, and have occupied a position of responsibility. Knowledge of Chemical Engineering would be an advantage. Applicants to state fully qualifications and training. Commencing salary about £500 per year.—Address, "999," Wm. Porteous and Co., Glasgow. P4085 A

JUNIOR TECHNICAL ASSISTANT REQUIRED by Consulting Engineer in London. Applicants must be capable draughtsmen with degree or equivalent technical qualifications. Works experience essential. State age, experience, and salary required.—Address, P4092, The Engineer Office. P4092 A

REPRESENTATIVE REQUIRED. Experience with Boiler-house Plants essential.—Write, stating age, experience and salary required, 7545, The Engineer Office. 7545 A

REQUIRED for Combustion Company, ENGINEER MANAGER, experienced all forms Furnace Heating. State fully career, salary wanted.—Address, 7593, The Engineer Office. 7593 A

RESIDENT ENGINEER REQUIRED for New Reinforced Concrete and other Buildings ; must have had similar experience and possess sound knowledge of Handling and Working of large plant, competent to set-out works, take levels, make surveys, supervise contractors' work, check quantities, make detail drawings, prepare specifications and supervise and control labour. Thorough understanding of good work essential. Salary £6 6s. per week. State age, qualifications and experience, with testimonials.—Address, 7560, The Engineer Office. 7560 A

SINGLE MAN, Good Education, WANTED to Act as RESIDENT ENGINEER on plants under construction. Only men of good stamp with some experience of installation work will be considered.—Address, 7571, The Engineer Office. 7571 A

TRAINED ENGINEER, with Experience, REQUIRED for Malaya by old-established City Firm. Commercial experience and also fair electrical knowledge ; must be well educated, with personality and appearance ; unmarried preferred, age 25 to 28. Salary about £750 per annum.—Address, 7588, The Engineer Office. 7588 A

TRAVELLER WANTED for London. Salary and commission. Connection essential with users of Air and Water Hose Fittings. Can carry non-competitive lines.—NEWTON SALES CO., Ltd., 39, Victoria-street, S.W. 1. P4087 A

WANTED, Good DRAUGHTSMAN, Preferably having Boiler experience. Give full particulars and present pay.—Address, 7594, The Engineer Office. 7594 A

WANTED, TWO DRAUGHTSMEN for Detail Work' Must have Motor Car experience. State age, experience, and salary required.—Address, 7598, The Engineer Office. 7598 A

DRAUGHTSMAN.—First-class CIVIL ENGINEERING DRAUGHTSMAN REQUIRED temporarily for Railway Engineer's Office in London ; must have had some outside experience on works.

Address, stating age, experience, and salary required, 7480, The Engineer Office. 7480 A

DRAUGHTSMAN, for Midland Works, with Good General Electric Control Gear and A.C. and D.C. Contactors experience. State age, experience, and salary required.—Address, 7601, The Engineer Office. 7601 A

DRAUGHTSMAN REQUIRED for East Midlands, one accustomed to Engine and Boiler, also General Designing. Some Structural knowledge desirable.—Address, stating age, training, experience, salary and date free, 7550, The Engineer Office. 7550 A

DRAUGHTSMAN REQUIRED by Steel Works Engineers ; knowledge of Furnaces and Gas Producers essential. State age, previous experience, and salary required.—Address, 7591, The Engineer Office. 7591 A

DRAUGHTSMAN, Senior, Having Sound Experience of Electric Controllers, Auto Starters, and Contactor Type Control Gear.—Address, stating age, experience, and salary required, 7600, The Engineer Office. 7600 A

DRAUGHTSMAN WANTED for Midland Works for Centrifugal Pump Design. State age, salary, and experience.—Address, 7611, The Engineer Office. 7611 A

DRAUGHTSMAN WANTED, Thorough Knowledge of Drawing and Workshop Practice essential ; Foundry Experience preferred. State age, salary and qualifications.—Address, P4082, The Engineer Office. P4082 A

DRAUGHTSMAN WANTED, Who has Experience in Cams and Tools for Automatic Screw Machines. A liberal salary will be paid to suitable man.—Address, 7445, The Engineer Office. 7445 A

DRAUGHTSMAN, with Sound Practical and Theoretical Experience of Medium and Small Size Steam Turbines. State fully in confidence experience and salary required.—Address, 7568, The Engineer Office. 7568 A

DRAUGHTSMAN (Young Junior) REQUIRED, with good general knowledge and initiative.—Full particulars, by letter only, of experience, age, and salary required, &c., to MILLIKEN BROTHERS and BLAW-KNOX, Limited, Wellington House, Strand, W.C. 2. 7615 A

EXPERIENCED DRAUGHTSMAN REQUIRED, accustomed Crushing, Grinding and Cement Making Machinery.—Apply, stating age, experience, and salary required, to "W. J. C." Edgar Allen and Co., Ltd., Imperial Steel Works, Sheffield. 7472 A

FIRST-CLASS DETAILING STRUCTURAL DRAUGHTSMAN REQUIRED. One accustomed to London buildings preferred. State age and salary required.—Address, 7555, The Engineer Office. 7555 A

SITUATIONS OPEN (continued)

EXPERIENCED DRAUGHTSMAN and ESTIMATOR REQUIRED, well acquainted with the Designing and Construction of Coke Oven or Gas-works Carbonising plant. Knowledge of German language an advantage.—Write, stating age, experience and salary, to Box Z.O. 932, c.o. Deacon's Advertising Agency, Fenchurch-avenue, E.C. 3. 7587 A

HEATING and VENTILATING DRAUGHTSMAN REQUIRED ; previous experience essential. Prospects for a man with push.—Address, 7556, The Engineer Office. 7556 A

MECHANICAL DRAUGHTSMAN REQUIRED for London, with sound experience of Engines, Boilers, and Plant Lay-out.—Address, P4091, The Engineer Office. P4091 A

MESSRS. DORMAN, LONG and CO., Ltd., Middlesbrough, REQUIRE the SERVICES of SEVERAL DRAUGHTSMEN, thoroughly experienced in Constructional Work for all kinds of Steel-framed Buildings, Bridgework, &c. Good prospects for suitable men.—Apply by letter, stating age, technical training, experience and salary required, to the MANAGER, Messrs. Dorman, Long and Co., Ltd., Bridge and Constructional Works, Middlesbrough. 7572 A

STRUCTURAL STEELWORK.—WANTED, TWO or THREE SENIOR DRAUGHTSMEN, with good experience of the Design and Detail of Steel-frame Buildings in London ; able to Design and Detail from Architects' Plans on own responsibility, including necessary site surveying. State salary required.—Applications only by letter to CHIEF DRAUGHTSMAN, Messrs. SMITH, WALKER, Ltd., 33, Tothill-street, S.W. 1. P4077 A

STRUCTURAL STEELWORK.—WANTED, TWO first-class JUNIOR DRAUGHTSMEN, with good experience of Steel-frame Building Work. Able to detail on own responsibility. Must also be quite competent to take dimensions at site. State salary required.—Applications only by letter to CHIEF DRAUGHTSMAN, Messrs. SMITH, WALKER, Ltd., 33, Tothill-street, S.W. 1. P4075 A

REQUIRED, TWO DRAUGHTSMEN, Experienced in Lay-out and Equipment of Chemical Plant. State full qualifications, age, salary, &c.—Address, 7562, The Engineer Office. 7562 A

TWO JUNIOR DRAUGHTSMEN WANTED TEMPORARILY in Westminster, used to Mechanical Details ; not less than three years' experience. Give full particulars and salary expected.—Address, 7608, The Engineer Office. 7608 A

CLERK (ESTIMATING), with Thorough Knowledge of Boilers, Tanks, Chimneys, Pipework, &c. —Apply in writing, giving age, experience and salary required, H. and T. DANKS (Netherton), Ltd., Netherton, Dudley. 7561 A

FOREMAN GRINDER REQUIRED for Large Works in London ; must be thoroughly skilled in producing the highest class of engine work and able to tactfully control labour.—Address, stating age, experience, and salary required, 7590, The Engineer Office. 7590 A

SITUATIONS WANTED

A.M.I.C.E., A.M.I.M.E., F.P.W.I. (Late R.E., Great War), having 25 years' railway and general experience, WANTS RESPONSIBLE POST, home or Colonies. Highest references ; can invest capital.—Address, P4089, The Engineer Office. P4089 B

CHILLED ROLLS, &c.—FOUNDRY MANAGER, with many years' experience in the manufacture of chilled rolls and various chilled iron castings, DESIRES CHANGE.—Address, 7581, The Engineer Office. 7581 B

CONTRACTORS' ENGINEER DESIRES POSITION, home or abroad. Capable supervisor, quantities, estimating, surveying, &c.—Address, P4060, The Engineer Office. P4060 B

ENGINEER, General Maintenance, 18 Years' Sea experience, 1st Class B.O.T., experience water-tube boilers. London or South preferred.—Address, P4079, The Engineer Office. P4079 B

ENGINEER (25) REQUIRES SITUATION. Complete technical training (A.M.I. Mech. E. exam., 1st class diploma, Regent-street School of Engineering) and 6 years' workshop practice ; also experience in petrol engine design and testing and in general experimental work.—Address, P4090, The Engineer Office. P4090 B

ENGINEER SALESMAN, British, Excellent Credentials, Argentina, Brazil, Spanish, Portuguese correspondent, influential commercial associations, Governments, railways, customers, willing REPRESENT first-class FIRM.—Address, P4076, The Engineer Office. P4076 B

FACTORY REORGANISATION and PRODUCTION EXPERT, A.M.I. Mech. E., with wide experience general engineering and costs, SEEKS responsible POSITION as General or Works Manager or Production Engineer. Moderate salary and bonus on results. —Address, P4050, The Engineer Office. P4050 B

INSPECTING ENGINEER, Mechanical and Electrical, with considerable experience in the inspection of power cables at makers' works, WANTS JOB with London firm of Consulting or Contracting Engineers, to assist in office and on outside work.—Address, P4093, The Engineer Office. P4093 B

MECHANICAL ENGINEER, Many Years' Experience with one of the largest engineering firms in the country, known to all the leading commercial houses, DESIRES RESPONSIBLE POSITION. Would consider investment.—Address, "Z.E. 924," Deacon's, Fenchurch-avenue, E.C. 3. 7586 B

MECHANICAL ENGINEER SEEKS ENGAGEMENT as Assistant Works Manager ; 30, A.M.I. Mech. E., A.M.I.A.E., 2 yrs. tech., 4 yrs. shops, 8 yrs. drawing-office experience, steam, petrol, and general work.—Address, P4080, The Engineer Office. P4080 B

MECHANICAL ENGINEER (25) DESIRES RESPONSIBLE POSITION. Excellent apprenticeship and experience with first-class firms. All classes steam work, centrifugal pumps and general machinery. Grad. I. Mech. E. Knowledge fuel technology.—Address, BM/KMRS, London, W.C. 1. P4086 B

PRODUCTION ENGINEER SEEKS APPOINTMENT ; expert knowledge of modern factory organisation, planning, works costs, automobile and small repetition work ; thoroughly practical and technical ; age 36.—Address, P4084, The Engineer Office. P4084 B

RESIDENT ENGINEER, POSITION WANTED as. Extensive experience on important public works. —Address, P4017, The Engineer Office. P4017 B

WORKS PROGRESS ENGINEER, with Wide Experience organisation and administration, is OPEN for an APPOINTMENT with progressive Firm, Electrical or Mechanical. Age 38. Partnership considered. Willing invest £300/400.—Address, P4081, The Engineer Office. P4081 B

DRAUGHTSMAN, Age 24, SEEKS Progressive POSITION ; 3 yrs. workshops, 2 yrs. technical training, and 4 yrs. in D.O. on structural steel work.—Address, P4094, The Engineer Office. P4094 B

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Railways and Road Transport.

IT has been decided by the Transport Committee of the Federation of British Industries to recommend the Grand Council of the Federation at its meeting on February 1st to exert the strongest opposition to the railway companies' Bills seeking powers to run road vehicles for transport services. The Committee argues that the loss of traffic in the higher classes over relatively short distances which the railway companies have suffered by the competition of the road hauliers has arisen because of the companies' inflated operating expenses and the reduced efficiency of the services which they provide. Much of this traffic, it is urged, could be recovered if the companies would reduce their rates and improve their services, and it is feared that if they were granted road haulage powers the incentive to effect these improvements would be removed. In the second place, the Committee contends that to compete with the existing road hauliers the companies would have to charge lower rates on the roads than on their railways, with the result that traffic will be diverted from the railways and as a consequence the position of the railways would be prejudiced against the remaining customers. Thirdly, it is feared that the companies with their immense resources could deliver an attack on the road transport industry of a kind and of a severity that would prohibit the development of independent road haulage undertakings. The proposal contained in the companies' Bills that they should be given power to make working agreements with any local road transport undertaking is felt by the Committee to contain a distinct element of danger, in that it would permit the companies to purchase a controlling interest in the larger road organisations and to buy out the smaller independent concerns at their own valuation. Generally, the Committee holds that the Bills would result in the companies crushing the competing carriers and then putting up their road rates with a view to protecting their interests as railways. There are no safeguards against this result in the Bills, and the Committee believes that no such safeguards can be found.

Traders' Opposition.

OTHER opinions hostile to the railway companies' Bills have been expressed. A strong argument against them was, for example, developed by Mr. Shrapnell-Smith at a recent meeting of the Yorkshire branch of the Institute of Transport. Mr. Shrapnell-Smith urged that special consideration should be given to the likely effect of the powers sought in strengthening the grip of the railway unions on our general system of transportation, and argued that if the companies were given general powers conditions should be laid down to prevent the flooding of our highways with excess and duplicate vehicles. The trade of the country, he contended, would not be helped by railway control and domination. About 80 per cent. of the passenger traffic diversion which the railways had experienced was, he believed, caused by the use of private motor cars and motor cycles, and he denied that there was any call for the railways to supplement the existing facilities for the transport of goods and parcels by road. The unrestricted powers which the companies sought were designed for one reason only—to give them a monopoly of our transportation system on land. The companies' argument that their powers to run steamships were analogous to and a precedent for the road powers now being sought could not be sustained. No railway, he said, had been given general sea transport powers. In every case their Acts confined their vessels to specific routes from specific terminal ports. Similarly they were confined in their powers to establish hotels and refreshment buffets to points on or near their lines. They had in neither respect been given a roving commission and they should not be allowed at large on the roads. There was a growing feeling among traders that the attitude of the railway companies covered some ulterior motive, and the fear of being placed solely in the hands of the railways was certainly not an idle one.

The Railway Companies' Case.

THE case for the railway companies is summarised in a statement that has been issued on behalf of the four grouped railways and the Metropolitan Railway Company. This statement calls attention to the necessity which railway companies are under to apply for Parliamentary sanction for any extension which they may desire to make in their activities outside those covered by their constitution or charter of incorporation. It is remarked that the object of this rule is to secure the protection of the shareholders' interests and to prevent the directors of a company from engaging in new enterprises and using for that purpose funds which were subscribed for a different object. The statement proceeds to comment upon the very important effect which the invention and development of the internal-combustion engine has had upon transport questions. It has, it is remarked, created a new transport unit and has tended to establish a more "retail" method of trading. Through the competition of the mechanical road vehicle the companies have lost a large amount of short-journey passenger traffic, a considerable amount of long-distance excursion and holiday business, and much of the goods traffic paying the highest rates. They claim that it is essential in the public interest that the powers they ask for in the Bills should be granted, and that the disabilities under which they suffer in the matter of road transport should be removed. The companies argue that it is unfair that while as ratepayers they have to contribute towards the cost of constructing and maintaining roadways, they are not allowed the same unrestricted use of them as their competitors. A good illustration of this unfairness, it is stated, is afforded by the proposed construction of a new Liverpool–Salford arterial road at a cost of £3,000,000. This road would run parallel with three existing railways and the Manchester Ship Canal, and would greatly facilitate competition. It is pointed out that the Railways Act, 1921, is designed to secure a definite net revenue to the railway companies, and that any losses which they may sustain in consequence of unfair road competition must fall to be borne by the traders and public who continue to use the railways.

Sir Westcott Abell.

WE understand that Sir Westcott Abell has resigned the office of Chief Ship Surveyor to Lloyd's Register of Shipping and is starting in business for himself as a consultant. Sir Westcott has had a distinguished career and has occupied several important positions. He was educated at the Royal Naval Engineering College, Keyham, and the Royal Naval College, Greenwich, and became in due course a member of the Royal Corps of Naval Constructors. Afterwards he was successively appointed Professional Secretary to the Director of Naval Construction, Instructor in Naval Architecture at the Royal Naval College, and Professor of Naval Architecture in the University of Liverpool. While at Liverpool he was appointed a member of the Board of Trade Committee on Load Line, becoming chairman of the technical committee of that body, which dealt primarily with the relation of scantlings to freeboard. In 1914 he was appointed Chief Ship Surveyor to Lloyd's Register of Shipping, and in that capacity was responsible for the preparation of the revised rules for the construction and classification of steel ships. The completion of that formidable task, for which Sir Westcott's work on the Load Line Committee eminently fitted him, leaves him now free to relinquish his official duties and to devote himself to private practice. During the war Sir Westcott rendered valuable services to the country as a member of the Merchant Shipbuilding Advisory Committee and of the Admiralty Shipbuilding Council, and also as Technical Adviser to the Controller of Shipping. For these services Sir Westcott was granted the honour of K.B.E. in 1920.

Large Engineering Deal in Lancashire.

THE announcement is made that Joseph Foster and Sons, engineers and boilermakers, of the Soho and Bow Lane Foundries, Preston, has purchased from Yates and Thom, Ltd., its Canal Foundry and Engineering Works at Blackburn. It will be recalled that Messrs. Yates and Thom went into voluntary liquidation a little over six months ago, and closed down the works after paying out the shareholders in full. At one time the Blackburn works employed close upon 1000 men, and operations will be started in about a fortnight's time with a complement of about 200 men. The Preston works of Joseph Foster and Sons are, we understand, although they have been recently extended, inadequate to deal with the large number of orders which the firm now has on hand. In addition to the manufacture of printing presses, the firm has specialised in textile, mining and chemical machinery, and steam boiler plant, and it is expected that all the larger work, including that connected with printing presses, will be carried out at the newly acquired Blackburn works, the purchase of which includes not only the buildings, but also the modernised machinery equipment, together with drawings and patterns. It is hoped that after a short time the works at Blackburn will again resume their normal activities.

A Notable Clydebank Launch.

ON Tuesday of this week, January 24th, an interesting event took place at the Clydebank Yard of John Brown and Co., Ltd., when the first of the three "Duchess" class liners which the firm has under construction for the Canadian Pacific Railway safely took the water. The occasion was further marked by the visit of the Prime Minister and Mrs. Baldwin to Clydebank, Mrs. Baldwin performing the naming ceremony and christening the ship "The Duchess of Bedford." The launch, which took place about one o'clock, was a very successful one, the ship being arrested by her drags about midstream, and safely berthed in the firm's fitting-out dock. Before the launch took place the three C.P.R. liners were side by side on their slips. The second ship, "The Duchess of Richmond," is about five months behind the "Duchess of Bedford"; while plating is only about to begin on the third ship, "The Duchess of Cornwall." A little further down the Clyde at Beardmore's Dalmuir Yard a sister vessel, "The Duchess of Atholl," is approaching completion. All these new liners have a gross tonnage over 21,000 and a deadweight carrying capacity of close upon 8750 tons. They have a length of 600ft., with a beam of 75ft. and a depth of 53ft. from the bridge deck. The propelling machinery comprises a twin-screw arrangement of Parsons geared turbines, designed for an output of 20,000 S.H.P., which will give the ship a service speed of about 17½ knots. The six oil-fired boilers are of the Yarrow water-tube pattern, and work at a pressure of 370 lb. per square inch with 250 degrees of superheat. There are also two cylindrical 200 lb. pressure boilers for auxiliary work and steam heating. Two Allen-B. and W. oil engine generator sets are also used for auxiliary power and lighting service. The machinery of "The Duchess of Bedford" was built by John Brown and Co., Ltd., under the superintendence and to the design of Mr. J. Johnson, the owners' chief superintendent engineer. Dr. C. S. Douglas, of Messrs. C. S. Douglas and Co., of Glasgow, was the consulting naval architect for the hull, and collaborated with Mr. Hugh Macdonald, the company's naval architect.

Richard Trevithick.

BELATED honour is to be done by his native county of Cornwall to Richard Trevithick, acknowledged by engineering authorities as one of the greatest inventors who ever lived, but whose remains nevertheless lie in an unmarked grave, and to whom Camborne still neglects to erect a memorial statue. The public-spirited action of Mr. James Olivey, the owner, in offering to place the cottage at Penponds, near Camborne, where Trevithick was born and lived, in the hands of a trust for preservation as a memorial of the inventor, has therefore been hailed with delight by those who recognise that the locomotive pioneer did not receive his just reward either from his contemporaries or from posterity. A small sum of money, some £200 or £300, will have to be raised in order to give effect to the generous offer of the owner, who is ready to transfer his entire interest in the property subject to a few simple conditions, such as reservation of the farm buildings and the securing of a right-of-way to the present tenant. The suggestion is that the whole of the front portion of the premises, which are practically in their original state, shall be devoted to an exhibition of Trevithick's inventions, and, if room can be found, for examples of the furniture and household appliances, farming and fishing implements, &c., more or less peculiar to Cornwall, which are yearly getting more difficult to obtain. No space is available at the Royal Institution of Cornwall for a collection of these folk antiquities. The rear portion of the cottage will probably be utilised as quarters for a caretaker. Mr. Olivey specifies that in the trust to be set up the Federation of Old Cornwall Societies, the Royal Institution of Cornwall and other kindred societies, the Camborne Urban District Council and the Parish of Penponds shall be represented. By the preservation of his cottage home, which it is anticipated will attract engineering visitors from all parts of the country and also from abroad, some measure of tardy recognition will be given to a great inventor to whose fame even Cornishmen have been somewhat oblivious.

New Cross-Channel Vessels for Belfast.

FOR some time past it has been known that the Belfast Steamship Company, Ltd., has had under consideration the replacement of its steamers—no.able among which are the "Graphic" and "Patriotic"—which maintain its cross-Channel service between Liverpool and Belfast. We are able to state that the company has now placed an order with Harland and Wolff, Ltd., for three fast motor vessels, which will be specially designed and built at Belfast for this service. The dimensions of the new ships are given as 345ft. in length, 46ft. beam and 19ft. depth, which are a little longer than the corresponding figures for the motor mail-carrying vessels on the Harwich-Esbjerg route. It is understood that excellent cabin accommodation will be provided, and that the engine power will be ample to enable the new ships to maintain with ease their scheduled time between the two ports. The engines will be of the Harland-B. and W. four-cycle, single-acting, trunk piston type, driving twin screws, as in the case of the Harwich boats. A complete description of the Harwich motor vessel "Parkeston," which also applies to the later motor vessel "Jylland," will be found in THE ENGINEER for August 14th and 21st, 1925. That account will be of interest as showing the type of machinery referred to. On Monday, January 23rd, William Denny and Bros., Ltd., of Dumbarton, launched the "Duke of Argyll," the second of three fast cross-Channel steamers which they are building for the L. M. and S. Heysham-Belfast service. The new steamers have a length of 360ft. and are designed for a speed of 21 knots. Twin-screw, single-reduction Parsons type geared turbines are installed, with six coal-fired Babcock and Wilcox water-tube boilers, designed for a pressure of 225 lb., and working on the forced draught principle with a closed stokehold.

The Dunstable Portland Cement Works.

No. I.

BY the courtesy of the Dunstable Portland Cement Company, Ltd., we have recently had opportunities of making thorough inspections of the new works which have been established by it just outside the town of Dunstable in Bedfordshire. That part of the country is strongly undulating, and is particularly interesting in that the three chalk strata—upper, middle and lower—outcrop at the surface at points which are in some cases close to one another. On the land on which the works have been built there are, but a short distance apart, outcrops of the middle and lower chalk, and their chemical compositions are such that, when mingled together in the correct proportions, the mixture contains, without any further additions, the exact ingredients required for the manufacture of Portland cement of high quality. Both chalks are easy to work, for both can be dealt with in wash mills after being passed through kibbling rolls to break up the lumps as quarried, and neither contains any flints, the occurrence of flints being confined to the upper chalk. There is, moreover, but little overburden. In some cases the chalk comes practically to the surface; in others, it is only covered by a few inches of soil; and nowhere does the depth greatly exceed 18in. The site therefore may be looked upon as being ideal from the point of view of raw materials, and the company owns some 600 acres, with usable material going down for perhaps hundreds of feet before the greensand which underlies it is reached.

In addition to their advantage regarding raw materials, however, the works are situated on a main road, from which there is easy access to many towns, large and small, within economic carrying distance by motor lorry, those towns including Bedford, Luton, &c., all of them rapidly growing and likely to need large quantities of Portland cement, while London is also within easy road delivery. Furthermore, the site is in direct connection by the line marked D in Fig. 2 with the London, Midland and Scottish, and the London and North-Eastern railway systems, so that coal and gypsum are readily brought to it, and cement, as readily, sent away. At the moment, the company has not got them, but it intends shortly to order a fleet of 20-ton bottom-discharging railway wagons, which will bring coal from various collieries in the Midlands—none of them at prohibitive distances away—empty their contents into a hopper, and then be hauled back to fetch further loads. In this connection it may be explained that extensive sidings have been provided—see E in Fig. 2—for the temporary use of loaded or empty wagons, and that the company has, for shunting purposes, an exceedingly handy standard-gauge locomotive made by the Sentinel Waggon Works, Shrewsbury.

As a final advantage, it may be said that during a large portion of the year there is a superabundance of water draining from the site to a sump, from which what is not required for the time being is pumped into a reservoir, which has a capacity of 100,000 gallons, and commands one set of wash mills. Arrangements have also been made by which, during the drier months of the year, the effluent from a nearby works may be drawn upon. So that from every point of view it is hard to imagine a better position in which to found a cement factory to operate on the "wet" system, which has been chosen by the consulting engineers, Messrs. Maxted and Knott, of 82, Victoria-street, S.W., by whom the works have been designed. Furthermore, it may said at the outset that the works have been laid out in a thoroughly practical and apparently most economical manner, and that the whole of the machinery, the chief contractors for which were Edgar Allen and Co., Ltd., of Sheffield, is of the highest class.

The respective chemical compositions of the two kinds of chalk were, at the times of our visits, such that approximately two-thirds of the middle chalk and one-third of the lower chalk were required to produce the correct mixture for the manufacture of Portland cement. For convenience in describing the plant and processes, we shall use the terms "chalk" and "clay," as is commonly done in the works, to describe the two materials, though "clay" is not actually a correct description to apply to the marl-like lower chalk. It may be possibly found in time, when the excavations of the two strata have proceeded far enough for the dividing line or zone between the two strata to be reached, that the material as excavated will, without any admixture or adjustment, have the correct composition for cement making, but at present, as we have said, approximately two parts of chalk are required to one part of clay. Consequently, we find, as might be expected, that the plant for dealing with the clay is of just half the capacity of that for dealing with the chalk. Both the clay and the chalk are led to the works in pipes in the form of slurry, being mixed in the desired proportions at a point some 270 yards away, as will be explained in due course. Our description will be more readily understood by the aid of the accompanying plan and of Fig. 2, which is reproduced from a bird's-eye photograph taken from an aeroplane during the time the works were being constructed.

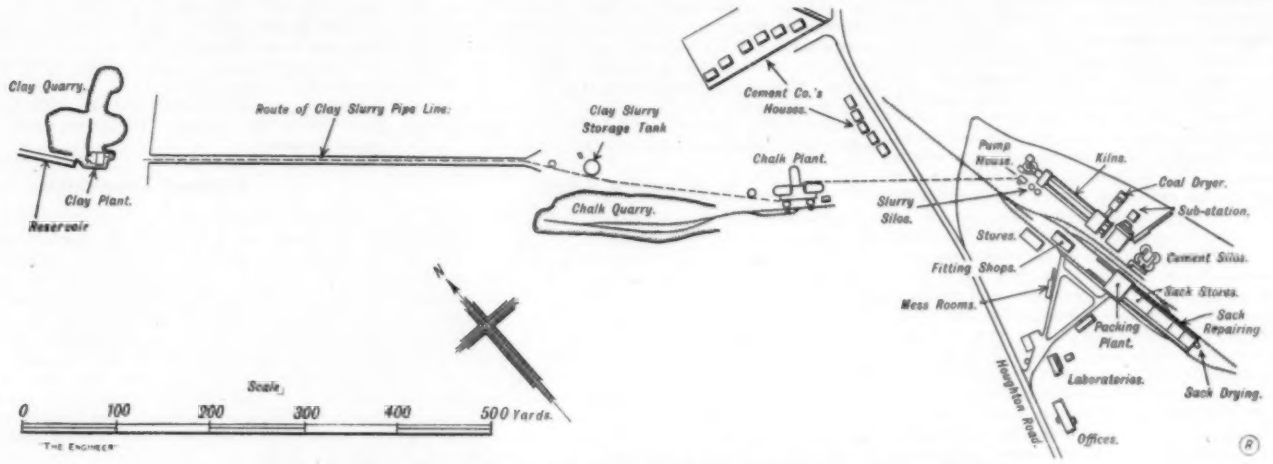


FIG. 1—DIAGRAMMATIC PLAN OF SITE OF DUNSTABLE PORTLAND CEMENT WORKS

The clay is at present being quarried at a point some 800 yards to the left of the point marked A in Fig. 2, and at an elevation of some 150ft. below it. The clay is being got out by a steam-operated Ruston caterpillar digger, having a bucket with a capacity of just over a ton. It is delivered direct into a train of four side-tipping steel trolley wagons which run on 2ft.-gauge lines laid on the floor of the quarry. For the most part the material is soft and homogeneous and consistent in chemical composition, though very occasionally shallow bands of much harder stuff are encountered. The chemical composition of these harder bands is almost identical with that of the surrounding material, but as the blocks into which they are broken by the digger are hard enough to put too severe a stress on the kibbling rolls, which were, as a fact, not designed to deal with them, they are removed by hand before the material is shot into the wash mill. The quantity of these hard lumps is not very large, however, the pile, representing some nine or ten months' working of the plant, not being of inconvenient proportions.

Two trains of light trolley wagons are at present being operated. When one train is full it is hauled by a small petrol locomotive from the quarry to the wash mill, a distance at the moment of some couple of hundred yards. Having done the journey with loaded trucks, the locomotive picks up the train of empty trucks and hauls it back to the quarry, sidings being arranged in the lines of railway to render these operations possible. Arrived at the wash mill, the loaded trucks are tipped one by one and their contents shot into a hopper over the kibbling rolls—Fig. 3. These rolls are actually two sets of fingers curved to sickle form and mounted on two parallel horizontal shafts. The fingers on the two shafts interlace with each other, and the two shafts revolve at different speeds, one making 1·9 revolutions a minute and the other 0·95. The machine works exceedingly well, the material being broken up into pieces of such sizes that they are readily dealt with in the wash mill. With regard to the latter, nothing much need be said, saving that it is 20ft. in diameter and that its arms are revolved at a speed of 20 revolutions per minute, by means of a three-phase alternating-current electric motor of 100 horse-power. The slurry discharged from the wash mill is forced by a three-ram plunger pump through 720 yards of 5in. piping to a concrete storage tank built near the point A in Fig. 2, the difference in level being about 120ft. It was at first intended that both the wash mill and the pump should be operated by the same motor, but it was discovered, when operations were started, that the "clay" formed a slurry of such a "stiff" consistency that one motor would be overloaded if it drove both mill and pump, and, accordingly, an additional motor was installed to drive the latter. The viscosity of the slurry is, in fact, much greater than is ordinarily experienced with slurries made from chalk marls in other parts of the country, and

FIG. 2—BIRDSEYE VIEW OF WORKS DURING ERECTION

it made itself felt in other parts of the works as well as in the clay pumping plant.

The chalk is dealt with in the buildings at the point A in Fig. 2. At the present moment the working face in the chalk quarry is about 200 to 300 yards away to the left, and the two points are linked together by exceptionally well laid standard-gauge lines of rails, Fig. 7. The overburden is being removed by means of a handy little caterpillar runabout tractor, which hauls a set of three-scraper soil removers termed Baker Maney scrapers, and was supplied by Tractor Traders, Ltd., Smith's-square, Westminster. The equipment is worked by two men—a driver and a man to operate the scrapers. On arriving at the point from which it is desired to remove overburden, the scraper operator first of all releases a catch holding the leading scraper free of the ground, so that the latter revolves on trunnions till its cutting edge engages with the surface of the ground and penetrates below the latter to a fixed amount. As the scraper is dragged forward, its container rapidly fills, when the cutting edge is automatically lifted from the ground. The operator then puts the second scraper to work, and subsequently the third. The train then proceeds to a dumping place where the material removed is automatically discharged, and goes back for the ground to be traversed once, since, as we have explained above, the overburden is, in places, very shallow. In other parts, however, it is necessary to go over the ground more often, but taking all that again to continue operations. The overburden is neatly and cleanly removed by this method, and we are assured that the cost of doing the work is remarkably low. In some parts it is only necessary into account, the cost of removal compares most favourably with that of any other method.

The chalk is quarried by means of a Ruston steam caterpillar digger, Fig. 6, page 104, which has a capacity of about 2 tons per stroke. The material,

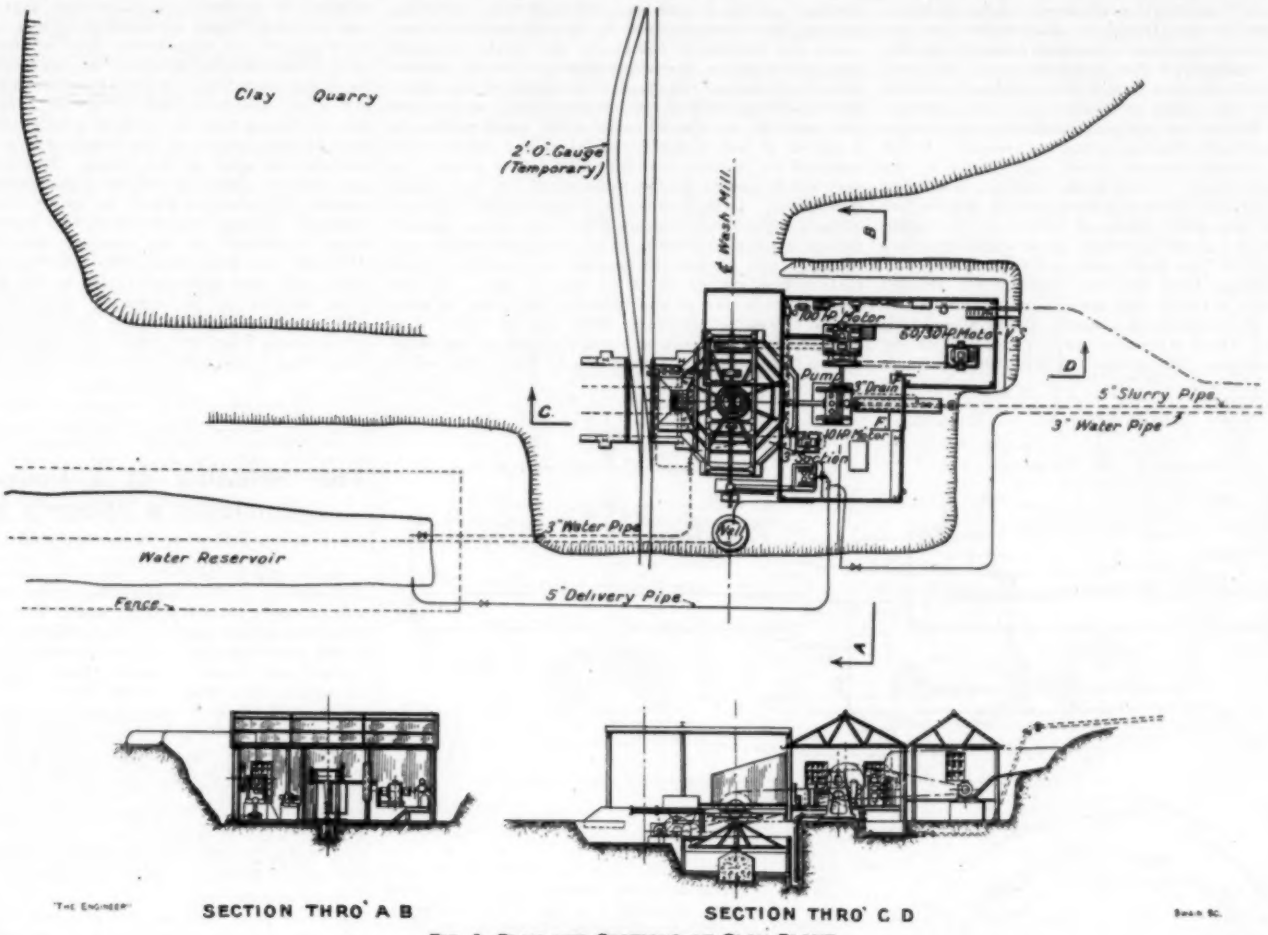


FIG. 3—PLAN AND SECTIONS OF CLAY PLANT

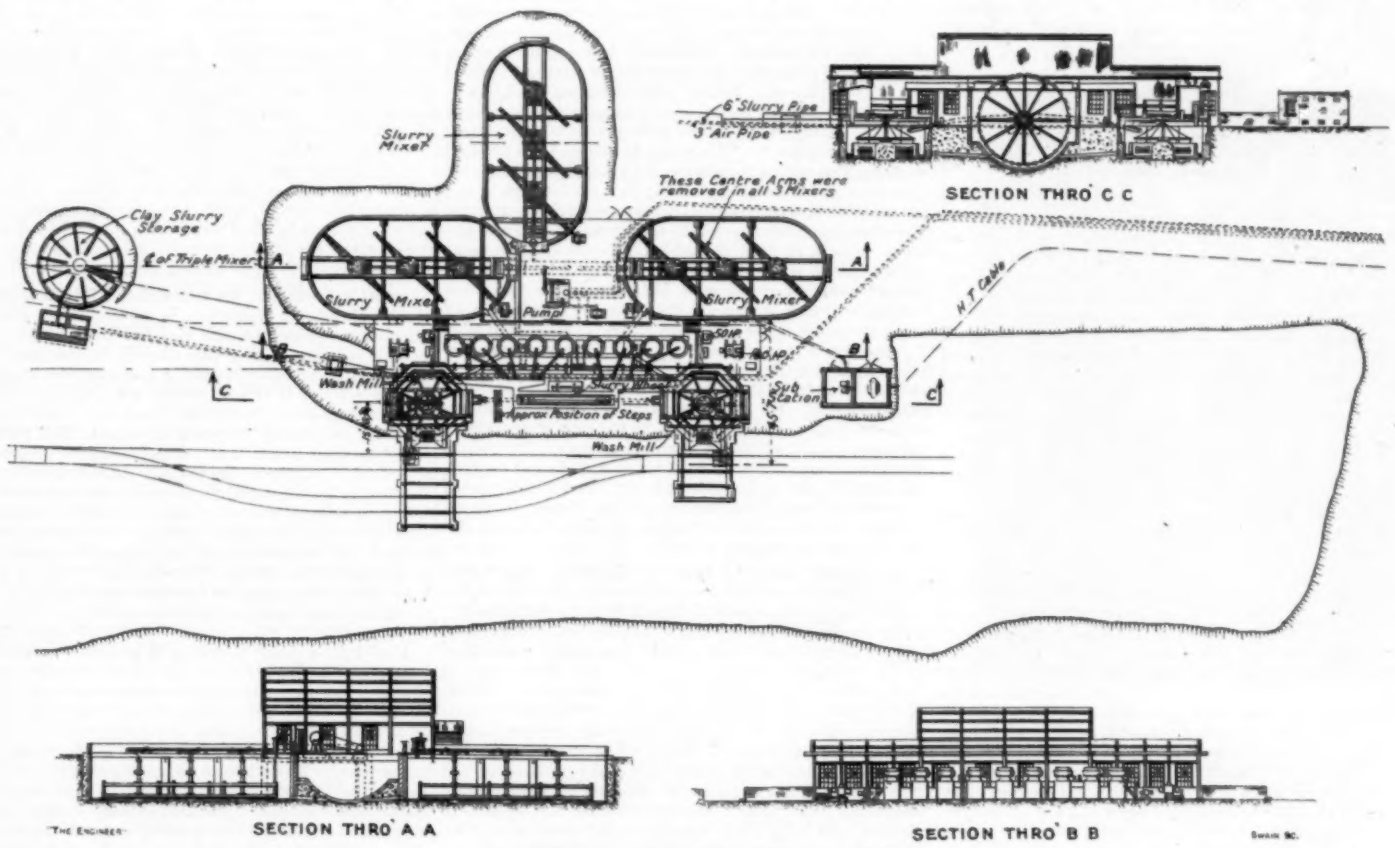


FIG. 4—PLAN AND SECTIONS OF CHALK PLANT

which is greyish white on being first exposed, and is of a fairly hard nature, is dumped direct into a train of two drop-sided tipping railway trucks, and taken direct to the chalk slurry works, by means of a petrol-driven locomotive made by the Motor Rail and Tramcar Company, of Bedford. Arrived there, the contents of each truck are discharged into one or other of the hoppers over two sets of kibbling rolls, of a type identical with that at the clay mill. Beneath each set of rolls is a wash mill of the ordinary type, 20ft. in diameter, the spider of which is, in each case, revolved at 20 revolutions per minute by means of a 100 horse-power alternating-current motor. While the chalk is being washed down, clay slurry, in the proportion arranged by the works chemist, is allowed to flow by gravity from the storage tank, referred to above, into the mills where it becomes thoroughly mixed with the chalk to form a thick slurry of a dark cream colour. The chalk plant is shown in Fig. 4.

The discharge from the wash mills flows through screens in the ordinary way into a common sump into which dip the buckets of a slurry lifting wheel 28ft. in diameter, which is revolved at a speed of 5 revolutions per minute. The buckets of the wheel discharge

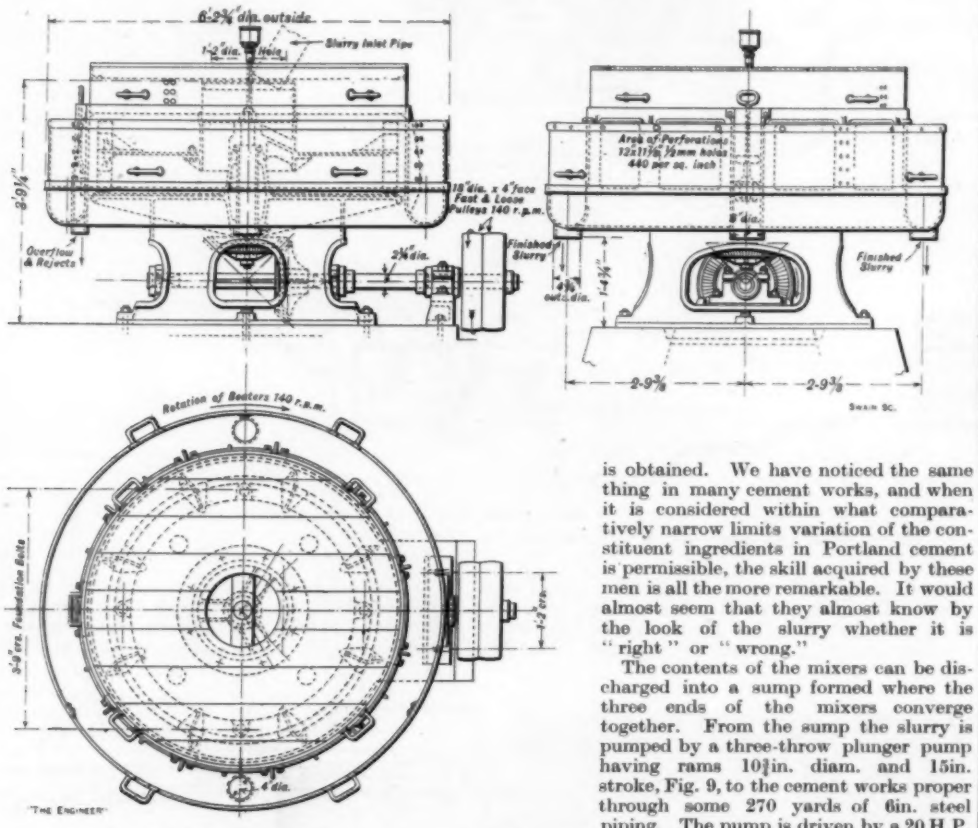


FIG. 5—SLURRY SEPARATOR

the slurry at the top into a wooden trough through which it flows into a header leading to a battery of nine slurry separators, Fig. 8, page 104, which are operated by belt from shafting which, in turn, is driven by two 50 horse-power motors, one at each end, and from which the lifting wheel is also driven. Drawings of one of the separators are given in Fig. 5. The machine comprises a vertical spindle driven by bevel gearing from a countershaft. Keyed to the vertical spindle is a hollow spider, through which the slurry is fed, and bolted to the spider is a horizontal beater plate carrying cast steel beater brackets and spring steel beaters. This portion revolves inside a cast iron casing, and by centrifugal force throws the slurry on to a series of sieves round the periphery of the casing. The fine slurry is forced through these sieves and flows round the annular trough outside the casing through two outlets for the finished slurry. The tailings or rejects from the screen flow out through a special opening in the casing, and are returned to the wash mill for further grinding. The direction of the rotation of the beaters is shown on the plan, and the speed of the machine is 140 revolutions per minute.

The discharge from these separators is into a wooden trough from which any one of three mechanical mixers —which are arranged to form three arms of a cross— may be fed. The mixers are tanks, sunk in the chalk and lined with brickwork. Each is 62ft. long and 30ft. wide, with rounded ends. Each was originally furnished with a set of three mechanical stirrers, each set being slowly revolved by means of 20 H.P. motors through gearing. As a matter of fact the centre of the three stirrers has now been removed from each of the mixing tanks, for the consistency of the slurry, to which we have already referred, was so thick and viscous that it was found that the motors were rather overloaded when three stirrers were at work, notwithstanding the fact that the same size of motor is operating precisely similar mixers in other parts of the country with slurries of ordinary consistency. Moreover, it was found that two sets of stirrers kept the slurry amply agitated, there being no tendency for the more solid particles to settle to the bottom. We may here mention that the slurry in the mixers, and indeed as it is supplied to the kilns, contains about 40 per cent. of moisture. We may also explain that samples of the contents of these tanks are frequently taken by the works chemists and analysed, any necessary alteration in the proportions of chalk and clay being then made by the attendants adding more of one or the other—as the case may require—to the contents of the wash mills. As a matter of fact, however, as far as our observations went on the occasions of our visits to the works, it is very rarely indeed that any change in the proportions is required. In spite of the fact that the men in charge of the wash mills are dealing with such varying quantities as truck loads made up of discharges of the contents of the buckets of mechanical diggers—which may or may not be all of the same weight, and may not always arrive at the point of discharge at absolutely the same intervals—they get, in time, to be extraordinarily expert in so apportioning the ingredients that a slurry of consistently even composition is obtained. We have noticed the same thing in many cement works, and when it is considered within what comparatively narrow limits variation of the constituent ingredients in Portland cement is permissible, the skill acquired by these men is all the more remarkable. It would almost seem that they almost know by the look of the slurry whether it is "right" or "wrong."

The contents of the mixers can be discharged into a sump formed where the three ends of the mixers converge together. From the sump the slurry is pumped by a three-throw plunger pump having rams 10¾in. diam. and 15in. stroke, Fig. 9, to the cement works proper through some 270 yards of 6in. steel piping. The pump is driven by a 20 H.P. motor. The piping is laid under ground, and where it passes under the roadway seen in Fig. 2 it is taken in one of two 12in. diameter earthenware pipes laid in concrete. The slurry is discharged into either one of two storage silos—see B in Fig. 2—which are circular vertical riveted steel tanks, 24ft. diameter by 53ft. 9in. total height, with funnel-shaped bottoms. The two silos contain enough slurry for thirty hours' operation of the kilns. In these silos the slurry is kept agitated by means of compressed air, for which purpose a three-cylinder Broom and Wade air compressor, driven by a 50 H.P. motor through gearing, has been installed. The air is delivered at the bottoms of the silos at a pressure of about 25 lb. per square inch through special agitation nozzles and valves by means of which it is possible to turn on or cut off and control the supply at will. The air thus supplied under pressure rises to the surface of the slurry in great bubbles, which cause sufficient agitation to keep the slimy mass thoroughly mixed.

In a house near the bases of these silos there are, in addition to the air compressor, two sets of three-throw plunger pumps with rams, 8¾in. in diameter by 16in. stroke, driven by a 20 H.P. motor. Ordinarily only one of these pumps is in operation, the other being kept as a stand-by. It lifts the slurry from a sump into which it can flow by gravity from either of the two silos, or into which if need be the slurry coming from the mixing plant can be discharged direct, and delivers it into two measuring tanks, arranged immediately above the charging ends of the two kilns. The pumps are capable of lifting considerably more slurry than is actually required for feeding the kilns, and considerably more than that amount is continuously pumped, the surplus, after flowing over a weir in each measuring tank, which gives a fixed head in the latter, being returned in a constant stream to the storage silos, a process which assists in keeping a good average mixture of the chemical constituents of the raw material.

The desired quantity of slurry is fed into the kilns by allowing the slurry to flow through an orifice of prescribed cross-sectional area under the influence of an accurately maintained pre-determined head. There are, of course, other methods of arriving at the same result, several of which we have described in the past, but that which is employed at Dunstable is very simple, is perfectly satisfactory, and, moreover, can be relied upon to operate with a minimum of supervision. As long as the flow of slurry is maintained considerably in excess of the requirements of the kilns, practically all the attention that is required is to make sure from time to time that the chute from the measuring tank to the kiln is kept clear. Alteration of the output of the kilns can be effected by varying the area of the orifice. Experiments have been made with the Rigby-Allen slurry-atomising process, by means of which the slurry is forced under pressure through nozzles into the kilns instead of being delivered in the manner described above. Although we understand that the experiments with this plant have been promising so far as they have gone, pointing to an increased output from the kilns and a more economical use of fuel, the apparatus was not working when we visited the works, but we understand that it will be in operation in the near future.

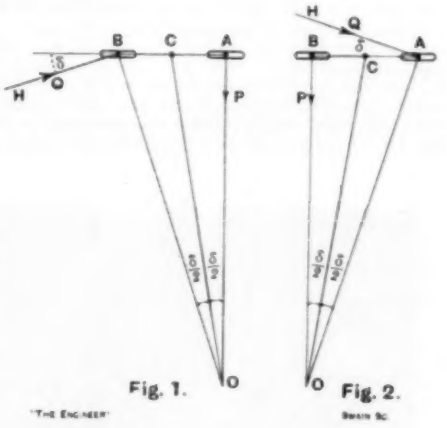
(To be continued.)

The Skidding of a Four-wheeled Vehicle on a Slippery Road.

By L. H. G. DINES, M.A.

AT a recent exhibition at the National Physical Laboratory at Teddington there was shown a very simple and effective model, which demonstrated the remarkable fact that if a four-wheeled truck, unprovided with steering lock, be travelling on a smooth surface and have its front wheels suddenly locked by means of a brake, there is no tendency for the truck, as a whole, to spin round; it simply continues to travel in a straight line as before, till the sliding friction pulls it up. On the other hand, if the rear wheels be locked, a state of instability immediately supervenes and the whole vehicle gyrates about a vertical axis till it comes to rest pointing the opposite way from which it started.

The writer does not remember coming across any dynamical analysis of this phenomenon, but so long



as great refinements are not entered into a comparatively simple explanation is available. For this purpose no principles are violated if we think of the vehicle as only having two wheels, in tandem. It is supposed to be travelling in a straight line with both wheels revolving freely, which implies that in both cases the reaction between wheel and road must be perpendicular to the plane of the wheel. It is proposed to show that if the front wheel cease to revolve, as the vehicle continues on its way, any tendency for it to change its orientation immediately and *ipso facto* brings a couple into play which tends to oppose the rotation. On the other hand, if the back wheel be locked, any small change of orientation which may accidentally be set up, immediately brings a couple into play which tends to increase the deviation. The motion in such case is unstable and an extensive spin is inevitable.

Fig. 1 is a plan in which A and B represent the points of contact between the wheels and the ground, and C is the centre of gravity, shown midway between A and B. The truck is moving from right to left, and the back wheel A is supposed to be revolving freely, while B is locked and therefore sliding over the ground. The wheel A must of necessity be travelling along the line A B, but wheel B is, at the instant considered, supposed to be sliding a little off the straight line along B H, making a small angle δ with A B produced. If A O and B O be drawn perpendicular respectively to A B and B H, then O is the instantaneous centre of rotation of the whole truck.

Now consider the forces acting under such conditions of incipient skid. P is the reaction between the wheel A and the ground and must act along A O. Q is the reaction between the wheel B and the ground,

and may be taken as acting in the opposite direction to that in which the sliding is taking place, that is, it acts along H B. If M be the mass of the truck and V its velocity at the instant, we have, by resolving the forces along C O, the approximate equation :—

$$\frac{M \cdot V^2}{C\,O} = P \cos \frac{\delta}{2} - Q \sin \frac{\delta}{2}$$

The approximation comes in because the angles A O C and C O B are not exactly equal to $\frac{\delta}{2}$ unless δ be indefinitely small.

Writing A C = C B = a, and remembering that when δ is small $\sin \frac{\delta}{2} = \frac{\delta}{2}$ and $\cos \frac{\delta}{2} = 1$ we have the transformed equation :—

$$P\,a = (M \cdot V^2 + Q\,a) \frac{\delta}{2} \quad .. \quad .. \quad .. \quad (1)$$

Now consider the forces tending to rotate the whole truck in the counter clockwise direction, that is, tending to increase the departure of its motion from the straight line. Taking moments about C we have :—

Rotating couple = $(- P\,a - Q\,a\,\delta)$.

From (1) this becomes $- (M\,V^2 + 3\,Q\,a) \frac{\delta}{2}$

This latter expression is essentially negative, which shows that directly the truck attempts to diverge from its original motion in a straight line a couple acts which tends to turn it back again.

Now, when the back wheel is locked instead of the front the conditions are as represented in Fig. 2, and instead of equation 1 we get :—

$$P\,a = (M\,V^2 - Q\,a) \frac{\delta}{2} \quad .. \quad .. \quad .. \quad (2)$$

The moment about C in the counter clockwise direction is in this case $(P\,a - Q\,a\,\delta)$, which by (2) becomes $(M\,V^2 - 3\,Q\,a) \frac{\delta}{2}$

This expression is positive if $M\,V^2$ is greater than $3\,Q\,a$, and any further increase in V produces a rapid increase in its positive magnitude. It follows therefore that, if V be greater than a certain limiting value, any deviation due to side slip of the locked wheel will immediately tend to grow worse and a condition of complete instability will supervene. Furthermore, it appears that such instability increases rapidly with V, so that the higher the speed the more sudden will be the gyratory spin. The limiting condition when $M\,V^2 = 3\,Q\,a$ corresponds to a value of V such that the locked wheel acting as a brake will pull the truck up in a distance $\frac{3\,a}{2}$. As the sliding resistance of a locked wheel on a slippery surface is small, the value of V so found is small, and a high speed is not therefore a necessary condition in order that a state of instability may occur.

The analysis further indicates a means by which a back wheel skid of a motor vehicle could be controlled. If the front wheel B can be turned parallel to the line A H without itself beginning to skid, when the turn has been effected, a method of analysis similar to the foregoing will show that C O has become infinite and that P is zero. The only force now left is Q, and the effect of this is to straighten the motion out again.

In practice, with a motor vehicle travelling at a high speed on a slippery road the instability of a back wheel skid is so great that there is very little time in which to effect any corrective action before the deviation has become unmanageable. The advice always given is to attempt to keep the head of the car straight, which agrees with the result just found.

Institution of Mechanical Engineers.

THE fifth report of the Steam-Nozzles Research Committee was presented at a meeting of the Institution of Mechanical Engineers, held in London on Friday evening, of last week. A summary of the Committee's first and second reports will be found in our issue of March 23rd, 1923, of the third report in our issue of May 23rd, 1924, and of the fourth report in our issue of May 15th, 1925. Below we give a summary of the report presented last week with a few notes explanatory of the work covered in the earlier reports.

The Committee's object is to test the efficiency of various forms of nozzles for steam turbines. For this purpose it adopted from the outset the "impulse" method of experimentation. In this method the steam from the nozzles under examination is directed against a flat plate, the force on which arising from the impulse of the steam against it is measured. The impulse plate is faced with layers of wire netting and wire gauze, and supports a cage composed of aluminium rings separated by thin washers. These precautions are intended to ensure that the steam shall leave the plate at a low velocity and entirely at right angles to its original direction of motion, so that the force on the plate is produced entirely by the impulse of the steam and not at all by its reaction. The plate and cage are placed inside a chamber, the walls of which are lined with wire netting to eliminate any eddies that may remain in the steam after it has left the plate. A vertical spindle attached to the underside of the plate passes through a gland at the foot of the casing and is connected externally to a weighing lever whereby the force on the plate is measured. The gland is driven at about 80 r.p.m. by a small electric motor, but the spindle is prevented from rotating with it. The spindle, therefore, can rise or fall within the gland in a practically frictionless manner.

The force F on the plate having been measured and the discharge m in pounds per second having been determined, the average actual velocity of the steam striking the plate is calculated from the formula $C_m = F\,g/m$. The theoretical velocity is calculated by equating the kinetic energy of the jet with the mechanical equivalent of the adiabatic heat drop d H through the nozzle in accordance with the formula $C = 300 \cdot 2 \sqrt{d\,H}$. The heat drop for this purpose is calculated from Professor Callendar's formula for the total heat of steam, and therefore there is required a knowledge of the pressures and temperatures of the steam on the two sides of the nozzles. The initial and final pressures and the initial temperature are observed experimentally. The final temperature is calculated from the fundamental adiabatic relationship $T_2 = T_1 \ (P_2/P_1)^{2}/_{11}$. The velocity coefficient of the nozzle tested is the ratio C_m/C, of the actual average velocity of the jet to the theoretical velocity, and the efficiency of the nozzle is taken as being represented by the square of this ratio.

In the first and second reports the Committee described the construction of the experimental apparatus and gave the results obtained with it from :—(*a*) A thin plate 20 deg. nominal angle impulse nozzle ; and (*b*) 1in. standard Parsons 480 B reaction blading. In the third report the results were given of tests on (*c*) thick plate 20 deg. nominal angle impulse nozzles ; (*d*) ¾in. standard Parsons 430 B reaction blading ; and (*e*) a set of straight elementary nozzles designed by Professor Mellanby. In the fourth report the nozzles tested were (*f*) thin and thick plate 12 deg. nominal angle impulse nozzles ; and (*g*) some additional straight elementary nozzles.

In all the tests described in the first four reports, the steam was in the superheated state on both sides of the nozzles, and the pressure on the exhaust side was that corresponding to the atmosphere. It was decided to carry out a series of tests on the nozzles at a constant back pressure of 45 lb. gauge. To implement this decision it was necessary to re-arrange and extend the experimental plant. In particular, a superheater capable of dealing with 8000 lb. of steam per hour had to be designed and constructed, and a mercurial differential pressure gauge had to be provided in order that the higher steam pressures to be used might be read to the same order of accuracy as the lower pressures of the earlier experiments. The superheater is gas fired. It receives steam having an initial superheat of 100 deg. Fah. from the Bloom-street Electricity Station of the Manchester Corporation, and can raise the superheat to, and maintain it constant at, any value up to 200 deg. Fah. At first special gauges of the Bourdon type, constantly checked and calibrated against a deadweight tester, were used for measuring the steam pressures on the inlet and outlet sides. It was found, however, that, with the higher back pressures used, these gauges by themselves were insufficient to ensure the desired degree of accuracy when the theoretical velocity of the steam leaving the nozzles was below about 800ft. per second. The mercury differential gauge, which was capable of reading up to 150 lb., was therefore added.

The nozzles examined under the new conditions of increased back pressure, so far as the work described in the fifth report goes, were the 20 deg. nominal angle thin—0·04in.—and thick—$\frac{1}{16}$in.—partition plate impulse nozzles of the second and third reports the only difference being that in both cases the height of the nozzles was reduced from 2in. to 1¼in. In addition, certain straight elementary nozzles of round, square and rectangular sections were examined.

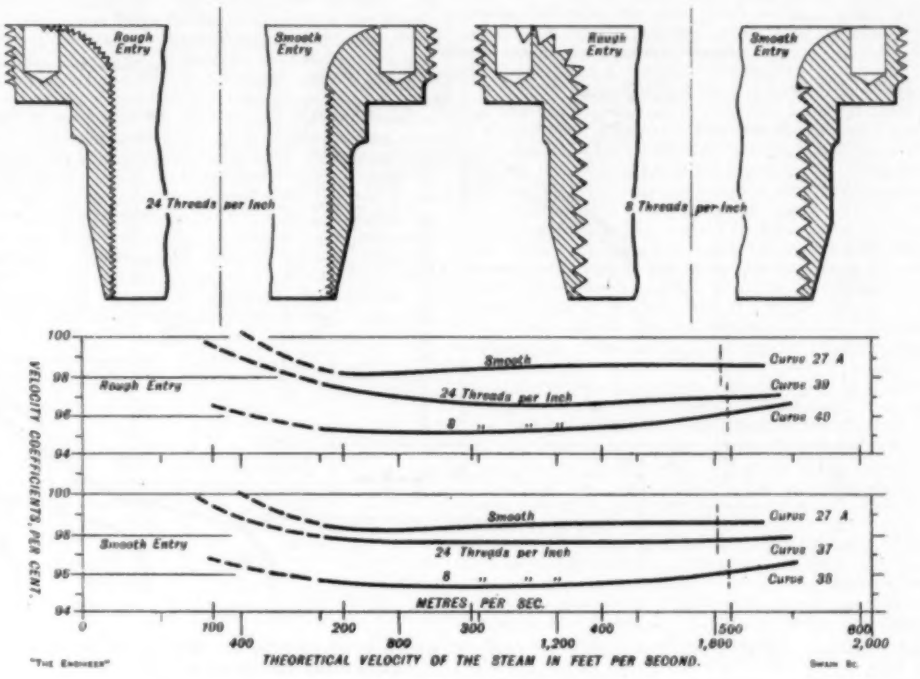


FIG. 1

As on previous occasions, the impulse nozzles were examined as originally made with the lengths of the parallel portions three times the width of the openings between the partition plates and then with this ratio cut down successively to 2 to 1, 1 to 1 and zero to 1.

All the tests conducted with the nozzles showed that there was no appreciable difference between the velocity coefficients and efficiencies of the 1¼in. nozzles with the increased back pressures and the same nozzles with lower back pressures, although in some instances they were slightly below those of the

FIG. 2

2in. nozzles with the lower back pressures of the earlier reports. In other words, the efficiencies of the nozzles tested were the same at equal velocities whether the back pressure was 45 lb. gauge or atmospheric.

Subsidiary tests were made to discover the effect on the efficiency of the degree of surface finish given to the nozzles. For this purpose the straight circular-sectioned nozzles were tested with the walls smooth and with the walls roughened. The roughening was carried out by cutting a Whitworth thread on the walls—see Fig. 1—the thread being 24 to the inch in one case and 8 to the inch in the other. With each

degree of roughness the nozzle was tested with a smooth entry and with an entry serrated by parallel grooves of the same depth and pitch as the thread. It will be seen from the curves given in Fig. 1 that the effect of surface finish has a considerable bearing on the efficiency of the nozzles and that the effect of roughening the entry is more marked in the finer than in the coarser threaded nozzle. The Committee remarks that while it is quite possible for nozzles to deteriorate to a roughness equivalent to 24 threads to the inch, representing a depth from crest to root of 26·7 mils, it is perhaps doubtful whether they ever acquire a roughness equivalent to 8 threads per inch, representing a depth from crest to root of 80 mils.

Another test was made to determine the efficiencies of geometrically similar straight elementary nozzles of different sizes. The nozzles tested were: (*a*) ¼in. diameter by 1¼in. long, and (*b*) 1¼in. diameter by 4⅓ in. long. It was concluded from the results arrived at that the efficiency of a nozzle shape is not affected by its size over a wide velocity range.

Finally tests were made to determine the effect of altering the shape of the exit of straight elementary nozzles. Four shapes were examined, namely, a circle, a square, a rectangle, and a wide slot, the area in each case being approximately 1 square inch. Within the degree of accuracy of the tests practically no difference in performance could be detected between the four nozzles.

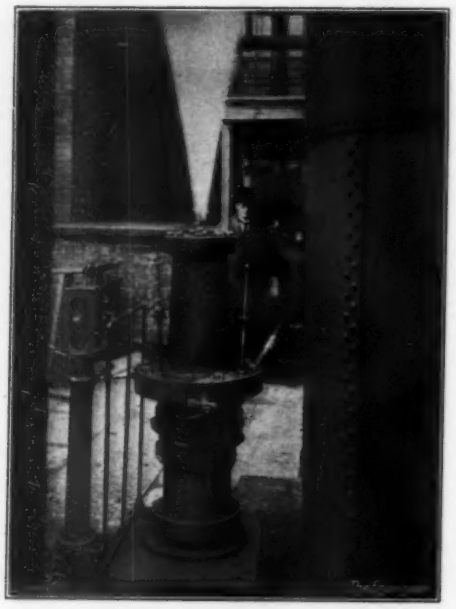


FIG. 5

Preceding the presentation of a summary of the paper by Dr. Telford Petrie, who has succeeded Dr. Stoney as Reporter of the Committee, Mr. W. H. Patchell, the Committee's Chairman, expressed the thanks of all concerned to the B.E.A.M.A. for its continued help in the research work. He remarked that the trade warmly appreciated the Committee's work and was already making great use of the results that had been established.

Mr. Hodkinson, speaking on behalf of Mr. H. L. Guy, of the Metropolitan-Vickers Company, was called upon to open the discussion. Some time ago, he said, tests had been carried out in his firm's experimental department on some practical types of convergent-divergent nozzles. Before an extensive research was attempted it was felt necessary to carry out a careful investigation into the validity of the "impulse" method of testing with steam velocities far exceeding acoustic velocity. There appeared to be a general impression that the accuracy of the experiments would be affected by the presence of standing waves in the jet after leaving the nozzle.

In order to determine the effect of the presence of such standing waves it was in the first place necessary to determine their wave length for the nozzle under examination. By discharging the nozzle into the atmosphere and gradually increasing the pressure drop across it, the standing waves became clearly visible when established, particularly if the steam were superheated at exhaust. Fig. 2 showed such a condition, the arrows indicating the successive anti-nodes.* It was found that the wave length was mainly characteristic of the nozzle dimension. Once the critical pressure drop necessary to establish the standing waves was reached further increase within the range covered by the tests did not sensibly affect the wave length. For the nozzle in question the wave length was approximately 2in.

In the nozzle tester installed in his firm's experimental department, arrangements had been provided so that the distance of the nozzle from the bottom of the cage could be readily altered, even during the progress of a test. It was therefore decided to test the nozzle at a series of distances between its exit and the top of the wire netting pad above the impact plate, representing varying fractions and multiples of the wave lengths. In that way the impact on the plate occurred at all pertinent phase relations with the standing waves. It followed that the influence of those standing waves was measured by the difference between the successive values determined for the nozzle velocity coefficient in the different nozzle positions. Fig. 3 showed the results of several series of such tests with the nozzle distance from the netting pad varying from 7·86in. to 0·9in. The test at 2·4in. distance was made with a steam temperature 260 deg. Fah. higher than that shown for 2·36in. distance. The standardised nozzle distance was 2·5in.

The tests were regarded as distinctly encouraging and as indicating that under extreme conditions the apparatus possessed the possibility of development for accurate measurements. In order further to explore the matter it was decided to carry out a "null" test on the divergent nozzle with the full steam quantity used in the impulse tests. The steam chest and nozzle box were erected as shown in Fig. 5 in the open, on a weighbridge, which was sensitive to additions or subtractions of 1 oz. on the pan. Steam was supplied to the apparatus through a straight horizontal 18ft. length of 2in. diameter pipe which was connected by 2ft. of flexible piping to the steam main. The axial thrust on the flexible pipe and the weight of the horizontal pipe were taken up by a flexible cable restraint.

With the apparatus erected as shown it was finally decided to use it as a reaction tester. The reaction was measured through the same range of pressure drops as had previously been run through in the nozzle tester. Fig. 4 gave the reaction observations plotted as a full-line curve. The corresponding measurements in the impulse tester were shown by the chain-dotted curve. It would be noted that for the lower range of pressure ratios across the nozzle the measured impulse was slightly greater than the reaction, whereas for the higher ratios the measured reaction was slightly greater than the impulse. For the pressure ratio corresponding to the actual "flare" of the nozzle the measured reaction was 1·66 per cent. greater than the measured impulse. That result was in line with the known fact that velocity coefficients measured by the reaction method were slightly higher than those deduced from the Institution's apparatus. The correspondance between the results arrived at by such widely divergent methods was distinctly encouraging.

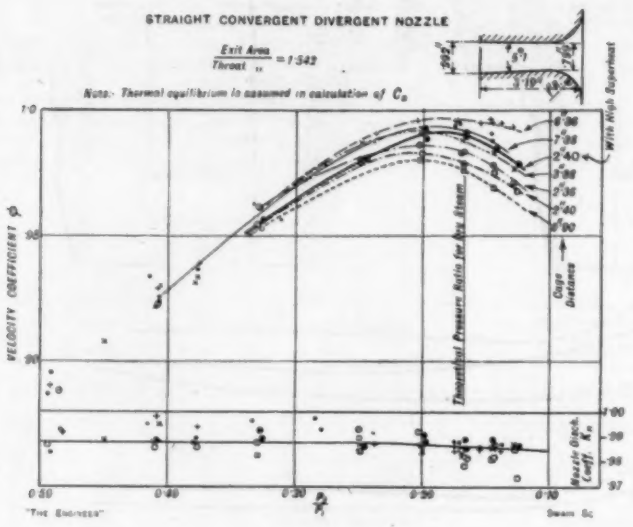

STRAIGHT CONVERGENT DIVERGENT NOZZLE
Exit Area / Throat = 1·542
Note:- Thermal equilibrium is assumed in calculation of C_v
VELOCITY COEFFICIENT ϕ
Theoretical Pressure Ratio for this Nozzle
With High Superheat
Cage Distance
Nozzle Discharge Coeff. K_n
$\frac{p_2}{p_1}$
"THE ENGINEER"

FIG. 3

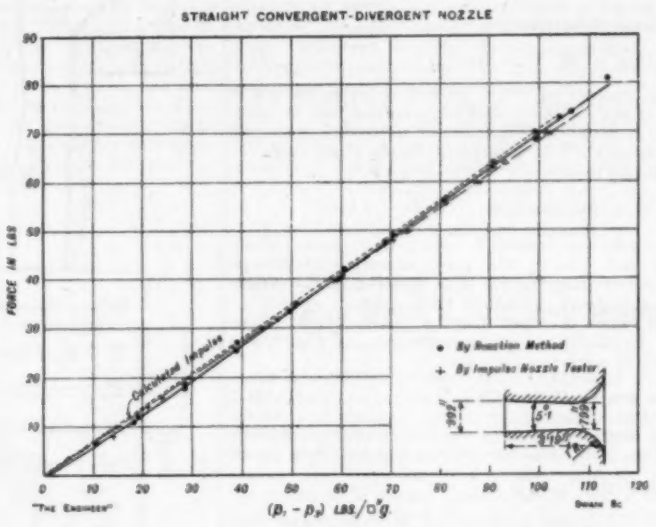


FIG. 4

The "null" test was carried out by attaching the cage in its normal position outside the nozzle box by means of the four screws shown in Fig. 5. It was found that a certain amount of condensed steam tended to hang on the slats of the cage. The method of test employed was therefore to turn on the steam and allow it to run until steady conditions were established. The apparatus plus the steam in it was then accurately balanced. The steam was shut off and weights were added to the pan to readjust the balance. The added weights represented the difference of mass of the steam in the apparatus caused by shutting the valve plus the difference between the impulse and the reaction.

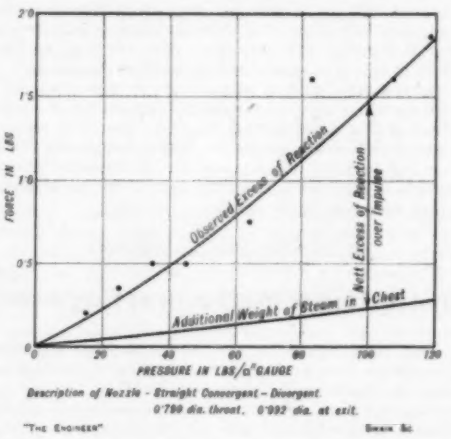

FORCE IN LBS
Observed Excess of Reaction
Nett Excess of Reaction over Impulse
Additional Weight of Steam in Chest
PRESSURE IN LBS/□" GAUGE
Description of Nozzle - Straight Convergent - Divergent.
0·799 dia. throat. 0·992 dia. at exit.
"THE ENGINEER"

FIG. 6

The results of an early series of tests conducted in that way were plotted in Fig. 6, together with the calculated mass of steam in the apparatus. At the designed pressure ratio the tests gave the reaction as 1·06 lb. greater than the impulse corresponding to a difference in velocity coefficient of 1·75 per cent. The "null" test with the cage in the open atmosphere and the comparison between the measured reaction and the measured impulse in the normal tests therefore gave almost exactly the same difference between the reaction and the impulse. Further, in both cases the difference was sensibly less than the width of the error "band" enclosing the results of the Committee's tests.

While the results given had to be regarded as in the nature of an interim report of an investigation still in progress, it was felt that their character was such as to establish the flexibility of the Nozzle Com-

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* It is to be feared that in our engraving the anti-nodes are barely distinguishable. In the slide shown by Mr. Hodkinson, of which Fig. 2 is a reproduction, three anti-nodes were clearly visible, with traces of a fourth and a fifth.—ED. THE E.

mittee's apparatus and the general accuracy of the Committee's methods and conclusions.

Mr. H. M. Martin said that the differences mentioned by Mr. Hodkinson were much smaller than he would have expected when standing waves were present. In view of certain attempts to improve on the Committee's apparatus, which seemed to have been made in ignorance of the principles governing its design, he might perhaps be permitted to indicate what those principles were.† As pointed out in the report, impulse testers fell into disfavour because the simple forms used by the early experimenters gave anomalous results. The Rugby experiments showed that those anomalies were mainly caused by eddies generated by the fluid as it escaped at a high velocity over the edge of the impact plate. Those eddies reduced the pressure at the back of the plate and therefore increased the apparent impulse. They accordingly covered the plate with a porous pad, which was intended to deprive the steam of most of its velocity before it reached the edge of the plate. The kinetic energy of the steam leaving the pad would then be too small to generate eddies of appreciable strength. The Rugby tests showed very conclusively that that aim was attained and that conclusion had been confirmed by an exhaustive investigation of the distribution of pressure inside the discharge box of the Manchester apparatus. That pressure had proved to be so uniform that it had been deemed unnecessary to install the packing of wire netting outside the cage which had been originally contemplated.

The object of the cage was to ensure that whatever fluid might enter or leave the movable part of the apparatus should do so when it was travelling at right angles to the jet. Any such flow would therefore have no effect on the recorded impulse. The nozzles were buried deeply in the cage in order to ensure that the topmost bar of the cage should be situated in stagnant steam. If there were fluid in motion in the neighbourhood of the top bar then by Bernoulli's principle there would be a corresponding reduction of the pressure at that bar and the impulse recorded would be too small.

There could, he thought, be little doubt regarding the general accuracy of the Committee's results. There was, however, one small anomaly still outstanding, namely, the fact that the impulse recorded was found in certain cases to vary slightly with the distance between the nozzles and the pad. The discrepancy was small even in the worst cases, and from the practical standpoint was of little importance. He was inclined to associate it with the phenomenon of flapping described in an earlier report, and suggested that every nozzle tester, whether of the impulse or the reaction type, must be subject to a dimensional effect. In the case of an impulse tester that effect would depend on the size of the cage and the position therein of the nozzles.

It was important to arrange matters in such a way that the dimensional effect was reduced to a minimum. For that reason a hole in a wide flat plate could not be considered a good form of nozzle. He was under the impression that in the Committee's work the distance effect had not so far been observed, except in the case of nozzles of the wide flat plate type. He thought that the detection of the small "distance effect" constituted a striking testimony to the care and honesty of the observers and to the sensitiveness of the Committee's apparatus.

Experiments made with a replica of the apparatus had shown that extreme care was necessary if conditions of dynamic similarity were to be secured. Not merely had the nozzles themselves to be exactly similar, but also the conditions on both sides of the nozzle plate. It was really extraordinary what exceedingly small departures from that requirement sufficed to vitiate comparative experiments, and yet when those apparantly trivial corrections were made the comparative results duly fell into line.

He had to confess that he had no alternative to propose to the Committee's method of representing roughness by grooving the nozzles with threads. He was, however, a little doubtful as to how far roughness thus produced was equivalent to that resulting from natural causes. In general, the friction of a pipe roughened by erosion or corrosion varied approximately as the square of the velocity of flow. Some recent experiments by Professor Gibson, however, had shown that the friction of a corrugated pipe increased at a very much faster rate, indicating that the physical character of the flow was not quite the same as in a naturally roughened pipe.

As matters stood at present, it seemed to him still to be impossible to frame a satisfactory specification of roughness. Nevertheless, the Committee's experiments might indicate an upper limit to the possible friction loss. In actual practice, the choking of passages by deposit might be more important than the consequent increased roughness of the surface.

Mr. B. Pochobradsky remarked that the steam turbine manufacturing industry was deriving great benefit from the Committee's work. The discovery of the variation of the efficiency of nozzles over the velocity range had transformed steam turbine design once and for all. The fifth report confirmed the results previously obtained, a fact which was very reassuring and which showed the accuracy with which the work had been and was being carried out. He was inclined to agree with Mr. Martin regarding the dissimilarity of the Committee's roughened nozzles with nozzles naturally roughened. He suggested that nozzles of commercial form corroded before testing should be investigated. He was glad to note that tests were to be made on the effect of roughness in curved nozzles. Dealing with the efficiencies of nozzles having different forms of orifice, but all having the same orifice area, he said that, in practice, designers were limited to nozzles having square, rectangular or slot-like orifices. He was glad to observe that circular orifices gave no better results than the practical forms, for he would have expected such circular orifices to have been the best. Continuing, he remarked that he had been surprised to find that a patent application based on the Committee's discovery that the efficiency of a nozzle was high at certain high and low velocities, and low intermediately had been filed in this country. He had entered a complaint against the granting of the patent, with the result that the application had been withdrawn. Recently, too, he had observed that abroad Brown, Boveri and Co. had patented the application of the Committee's results to reaction turbines for fixed and moving blades. That use of the Committee's research work ought, he thought, to be stopped.

Mr. J. C. Oakden remarked that the Committee's results were in good agreement with those indicated by theory. Proceeding, he argued that the efficiency of a nozzle could be represented by the expression Eff. $= f\left(\frac{v\,d\,\rho}{\mu}, r\right)$. At high speeds the energy loss was due almost entirely to eddies and compression waves, and consequently the term $\frac{v\,d\,\rho}{\mu}$ would disappear leaving the efficiency a function solely of r, the pressure ratio. At low speeds, on the other hand, the density of the gas would remain almost constant throughout the nozzle, and the term r would disappear, leaving the efficiency a function of the exit velocity v, the nozzle size d, the density at exit ρ and the viscosity μ. The equation Eff. $= f\ (r)$ should, however, be used with caution when high speeds and small nozzles were being studied, for what was a high speed with one nozzle might not be a high speed with another of different size.

Mr. A. H. Fitt said that he was struck by the fact that the nozzles chosen for research were not typical of commercial practice. The results obtained from them were therefore comparative rather than absolute. With the steam pressures employed becoming higher, there was a definite tendency to use machined nozzles. The Committee's thin and thick plate nozzles did not represent practice, either in their form or their pitch, which was too close. Practical forms of nozzles were as illustrated by the slide—see Fig. 7. He would like to know more about the finish of the Committee's nozzles, both in the cast and the cast-in types. He was not convinced that the roughness tests described in the report threw any light on what really happened in commercial nozzles. The Committee's result on the absence of variation in the efficiency of nozzles of similar form, but different dimensions, was to have been expected, but he thought the absence of effect in the case of nozzles having different shapes of orifice was extraordinary. He would have expected to find that the formation of eddies in nozzles having square corners would have had a marked effect on the efficiency.

Dr. A. P. Thurston drew attention to the analogy between the Committee's research and the work done in aeronautics on boundary layers. The aeronautical problem consisted of discovering how to modify or eliminate the boundary layer in order to obtain maximum efficiency. In an attempt to modify the boundary layer, rotary cylinders had been placed in the nose of a machine and had been found to improve the efficiency. The boundary layer and the efficiency of the flow over the body of a machine were found to be greatly affected by the position at which the engine took in its air supply and exhausted its products.

Mr. I. V. Robinson said that Mr. Pochobradsky had not exaggerated the lasting effect which the Committee's work was having on the design of steam turbines. Abroad, as in this country, that work was held in high regard. He wondered, however, whether the utmost had been done to bring to the notice of overseas turbine buyers the reputation which British turbine builders were acquiring through the Committee's work.

Dr. Gerald Stoney congratulated the Metropolitan-Vickers Company on its tests, and said that the results of those tests confirmed those obtained by the Committee. It was very interesting to learn that the cage could be employed at velocities above the critical. Turning to the report, he commented upon the good results given by a nozzle with an orifice in the form of a slit. In Parsons turbines, he said, openings of as much at times as 50 to 1 in ratio were used, and were quite satisfactory. Dealing with the question of roughness, he asked Mr. Pochobradsky how he proposed to set up a standard of roughness if naturally roughened nozzles were to be tested. The effect of roughness in the nozzles was, he said, much more important in impulse turbines than in reaction turbines.

Dr. Petrie briefly replied to the discussion, which he described as helpful and encouraging. The Committee was seeking information on the action of steam nozzles, and until that information was available the Committee would not formulate any theories on the strength of the results so far obtained. The nozzles used in the Metropolitan-Vickers tests were as different as possible from the Committee's, and pressure ratios as high as 95 lb./15 lb. had been used, whereas the Committee had never gone beyond the critical ratio. Nevertheless, the two sets of results agreed very closely.

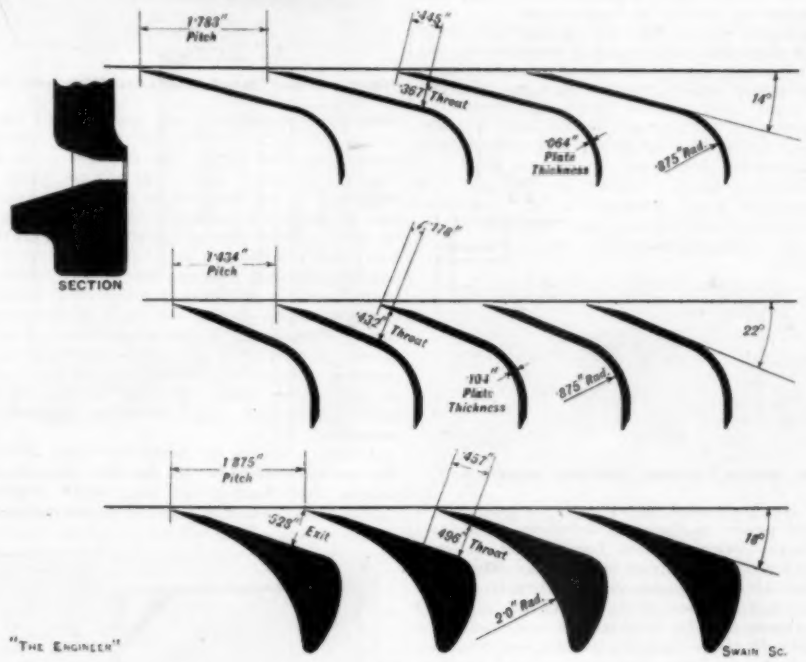

FIG. 7

† Mr. Martin was chiefly responsible for the design of the Committee's apparatus. The design was based on experiments which he and Mr. F. Samuelson made at Rugby.—ED. THE E.

THE IRON AND STEEL INSTITUTE.—The annual meeting of the Iron and Steel Institute will be held on Thursday and Friday, May 3rd and 4th, 1928, at the House of the Institution of Civil Engineers, Great George-street, London, S.W. 1. At this meeting Mr. Benjamin Talbot will assume office as the President for the year 1928–29, and the meeting will take place under his presidency. The annual dinner will be held on the evening of Thursday, May 3rd, at the Connaught Rooms, Great Queen-street, London, W.C. 2. Particulars of the arrangements will be circulated later. The autumn meeting will be held at Bilbao, beginning Monday, September 24th. An influential local Committee has been formed, with Mr. Alfonso Churruca, Vice-President of Altos Hornos, as chairman, and Mr. Luis Barroiro, director of Minas del Morro, as honorary secretary. Arrangements are in progress for a special train service *vid* Dover, Calais Paris, Irun, to convey the party to Bilbao, leaving London on Friday, September 21st. After the meeting excursions to Madrid, Toledo, Sagunto and Seville are contemplated. Further particulars concerning the cost of attending the meeting and excursions will be circulated later.

Physical and Optical Societies' Exhibition.

No. III. (*conclusion*).*

HITHERTO many switches used on resistance boxes and Wheatstone bridges have suffered from the defect that the resistance of the contact varies, particularly when the ebonite base warps. To overcome this defect H. Tinsley and Co. have developed a special type of switch designed on the lines shown in Fig. 25, in which it will be seen that the stud and contact ring are split and that the brush is introduced into the apertures. The use of these switches is said to have made a very large improvement in the consistency of moving contacts. A long series of tests under practical conditions has shown that on small switches, such as those that were exhibited, the variation does not exceed more than 10 michroms per contact. Larger size switches are made and different materials can be used in the construction. The studs can be faced with silver-gold or the switch leaves themselves can be made of silver-gold. This type of switch is now being generally adopted for resistance boxes and bridges. Many of the firm's resistance boxes, bridges, and potentiometers are now fitted with a bakelite cover to protect the contacts from dust and to screen the ebonite from the action of sunlight. Another new piece of apparatus exhibited was a slide wire about 10 m. long, arranged on a circular drum with a calibrated scale with 1000 divisions, readable to one-tenth of a division, so that an accuracy of one part in

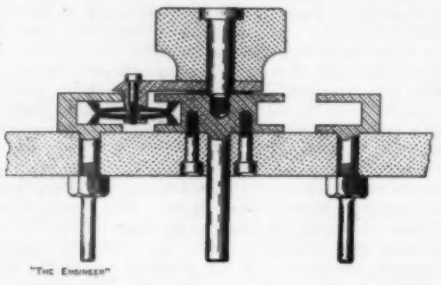

FIG 25.—RESISTANCE BOX SWITCH—TINSLEY

10,000 can be obtained. The resistance of the slide wire can be as much as 10 ohms and end coils are fitted so that, when these coils are in use, the slide wire becomes one-tenth of the total resistance, thus increasing the accuracy proportionally. The slide wire is particularly suitable for the measurement of the conductivity of electrolytes, a measurement of increasing importance for controlling chemical processes. A simple form of D'Arsonval galvanometer that was exhibited is especially intended for technical colleges and private experimenters, and it is one of the cheapest reflecting galvanometers on the market. Cobalt steel magnets are used and the suspension piece is interchangeable so that different resistances can be employed in the same galvanometer. Standard air condensers of the highest possible accuracy were exhibited by this firm, which was also showing a vibration galvanometer of the Schering pattern. The instrument is of the moving iron type and tuning is carried out electromagnetically, so that the instrument can be tuned from a distance by altering the current through the field coils. The degree of magnetisation of these coils alters the period of vibration of the moving iron.

An indicating and remote control system, known as the Aegir system, capable of showing the depth of

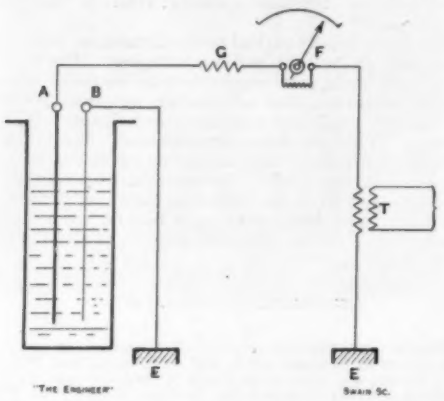

FIG. 26—AEGIR DEPTH INDICATOR—ISENTHAL

water in wells, canals, rivers, reservoirs, &c., and of controlling electrical circuits, such as motor circuits, was one of the exhibits of Isenthal and Co., Ltd. The action is based upon the measurement of current in an electrical circuit, when the resistance of the circuit is varied at one particular point. The variation is brought about by the degree of immersion of a high-resistance, which is suspended in the water or other liquid the depth of which has to be determined.

* No. II. appeared January 20th.

In Fig. 26 A represents the resistance element, which is mounted close to a metal rod B, that supports the electrode A by means of insulators. In order to prevent electrolytic action alternating current is used, and it is supplied through a transformer T. A milliampère meter F is used as an indicating instrument, and it can be calibrated in cubic metres or inches. By suitably dimensioning the resistance rod and adjusting the rheostat G, it is possible to make the readings correspond with the

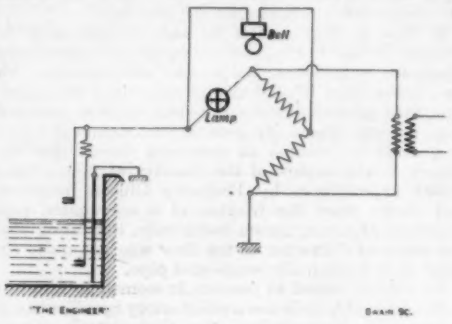

FIG. 27—AEGIR ELECTRIC ALARM—ISENTHAL

depth of the liquid. In a slightly modified form the scheme may be used for giving acoustic and visible signals when low or high water level is reached. In this case contacts in a tank or other receptacle are inserted in one of the arms of a Wheatstone bridge, as shown in Fig. 27, which is self-explanatory. When the bridge is balanced the bell no longer rings.

The resistance rod A, Fig. 26, consists of a combination of short resistance units of different specific conductivity supported by means of insulators on a galvanised metal tube B, which is earthed. The

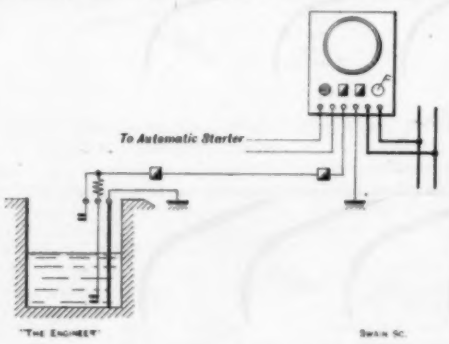

FIG. 28—AEGIR CONTROL SYSTEM—ISENTHAL

length of the horizontal water path through which the current passes is therefore definitely fixed, and the resistance—other factors being constant—will only vary with the depth of immersion. The effect of moisture on the resistance rod, when the liquid sinks, does not, we are told, affect the accuracy of the indication. The indicator is mounted on a small panel with the necessary cut-outs, switches, &c., and if desired a recorder may be provided in place of the indicator or a recorder may be used in addition to the indicator. When the apparatus is used for

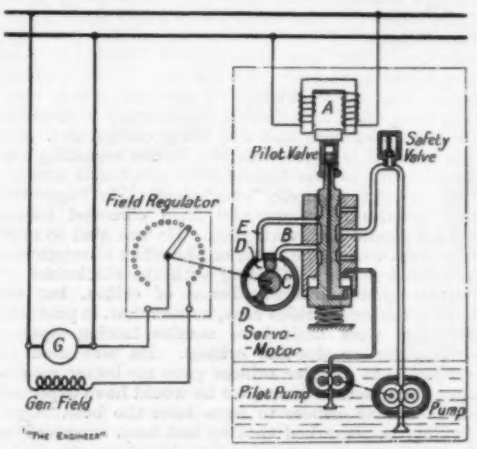

FIG. 29—VOLTAGE REGULATOR—ISENTHAL

starting motors a relay is employed, as shown in Fig. 28, and when the water attains a predetermined level the armature of an electro-magnetic switch is attracted, and it either opens or closes the starting circuit, according to whether the pump is supposed to fill or empty the tank in which the contacts are placed. The scheme may also be utilised for indicating gas pressure.

Another exhibit on Isenthal and Co.'s stand was the "N.C." rapid action regulator, which works without vibrating contacts and possesses the property of exerting a considerable mechanical force in direct proportion to the variation in voltage, current, or power factor, &c. Briefly, the electromagnet A—Fig. 29—is connected across the mains or across the terminals of a generator. Between the poles of this electromagnet a spring-controlled armature moves, and this armature displaces a slide valve which controls a supply of oil under pressure to a servo motor. If, for example, the generator voltage drops, the pull on the armature is reduced and the slide valve moves downward. The oil under pressure then enters the tube B and the space C, whilst the oil in the space D escapes by way of the pipe E. The wing of the servo motor is therefore displaced and the arm of the field regulator is moved. This increases the voltage of the generator and the armature between the poles of the magnet A is pulled upwards. When the correct pressure has been attained the armature and slide valve take up the mid position, so that no further regulation occurs. The pump and all the other mechanism, except the electromagnet, are contained in an oil tank, and the pump is usually driven by a motor. It is obvious that the apparatus can be put to other uses besides that of regulating the voltage of an electric generator.

The short-wave receiver, shown in Fig. 30, was one of the exhibits of the Marconi Company. It is a four-valve receiver suitable for the reception of tele-

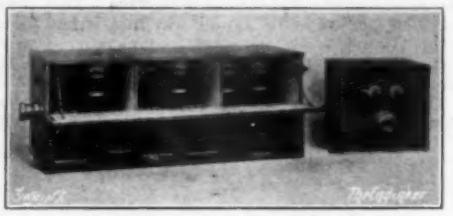

FIG. 30—SHORT WAVE WIRELESS RECEIVER—MARCONI

phone and telegraph signals, and covers a wave range of from 15 m. to 150 m., by means of two pairs of interchangeable coils. The receiver is so designed that re-radiation, which has always been a great drawback of self-heterodyne detector valve circuits, can be entirely eliminated. The receiver may thus be used in an oscillating condition, without the possibility of interfering with other receivers in the neighbourhood. Another noteworthy feature is the provision of a separate coupling box, which allows the aerial to be erected well away from the operating cabin. In cases in which local conditions do not permit of the erection of an aerial directly connected to the receiver, or in cases in which an aerial might be subject to interference from electrical machinery or other local interference, this feature is obviously of importance.

Another receiver exhibited has been developed for the use of survey parties for the reception of time signals from high-power long wave stations. As shown in Fig. 31, it is a portable four-valve receiver,

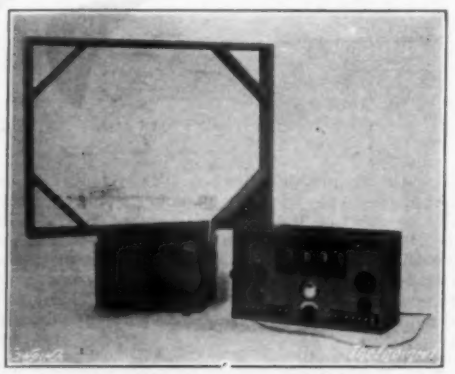

FIG. 31—PORTABLE WIRELESS RECEIVER—MARCONI

built to stand the roughest service in any climate. Its wave range is from 15,000 m. to 22,000 m., and in view of the special service for which it is designed, low-filament current valves run from dry batteries are used. A robust frame aerial is usually employed with the receiver. If additional freedom from interference or actual bearings are required, an open aerial in conjunction with the frame aerial, and a small phasing unit, can be used to enable the "heart-shape" polar diagram of reception to be obtained. The selectivity of the receiver is said to be very high. The tuning is exceedingly simple, and is reduced to the setting of two calibrated dials, the position of which may be read from a chart that accompanies the receiver.

In addition to these receivers, which cover a wide field of application, the Marconi Company exhibited a Marconi-Reisz microphone, which, although small, takes a place in the front rank of modern wireless apparatus, on account of the important function it fulfils. The microphone is in practically universal use in this country and abroad for broadcasting purposes. A G.A. 2 microphone amplifier used in conjunction with the microphones was shown. It is a three-valve resistance capacity coupled amplifier,

with input and output transformers. It is used as a first-stage amplifier, the output of which is suitable to operate, through a control amplifier, the modulating system of broadcast transmitters, or the input circuits of power amplifiers for sound projectors used in public address systems.

Apparatus for measuring the energy emitted by high explosives when they are detonated was shown by Mr. T. Carlton-Sutton, of the Research Department, Woolwich Arsenal. Apparatus for this purpose has hitherto dealt either with the explosive in the unconfined state or with small quantities, say ¼ oz., of the confined material. Mr. Carlton-Sutton's apparatus can deal with charges of as much as ½ lb., even when they are confined in heavy steel envelopes, such as are used in ordnance. The apparatus has made it practicable to study the energy emitted by insensitive material, the detonation of which has to be initiated by means of a considerable charge of a more sensitive explosive and to differentiate between

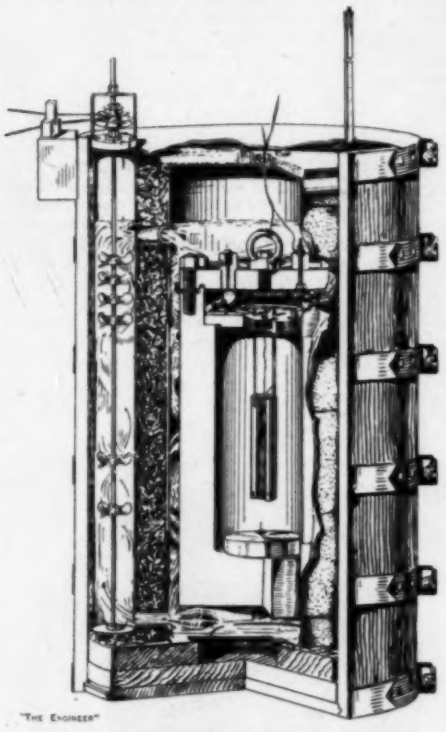

FIG. 32—DETONATION APPARATUS—SUTTON

the anomalous mode of decomposition of the first ounce or so of explosive and the modes of decomposition characteristic of the explosive of larger quantities. The energy emitted is measured as the heat evolved. The explosive, pelleted to the required density, is placed inside a heavy steel envelope, which—as shown in Fig. 32—is suspended inside a larger closed steel vessel. This vessel weighs 7 cwt., and after being sealed is lowered into a calorimeter, the water within which is stirred by means of propellers. The charge is ignited electrically. The temperature rise as a rule does not exceed 2 deg. Cent., and as a consequence the development of thermometers for measuring with precision temperature rises of this order has formed an important part of the research.

One of the most interesting things exhibited by Everett Edgcumbe and Co., Ltd., was the Warren synchronous motor, shown in the drawing, Fig. 33. The rotating field is produced by the shading rings

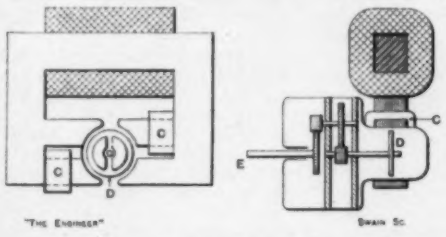

FIG. 33—SYNCHRONOUS MOTOR—EVERETT EDGCUMBE

C C, and the annular steel rotor D is drawn round by hysteresis, the effect of eddy currents being negligible. The rotor runs at synchronous speed, irrespective of the load, and as a result of the gearing the spindle E makes one revolution per minute or one revolution per second, as desired. These motors may be used for many purposes, and they have been found to be particularly suitable for driving graphic meter charts which can be accurately synchronised, instead of being dependent upon the time-keeping of a number of separate clocks. The firm has devoted a great deal of attention to improvements in induction ammeters and voltmeters, which in the past have been subject to large errors arising from changes of temperature and frequency. The working parts of the company's new instrument is shown in Fig. 34. The usual shading ring has been eliminated, and the necessary phase displacement is obtained by a second electro-magnet, the current in the winding of which is made to lag about 45 deg. by shunting it with a non-inductive resistance. By properly proportioning the inductances and temperature coefficients of the various elements, it has been possible to produce induction ammeters and voltmeters, which comply with the first grade requirements of B.S.S. 89. An induction ammeter wound for 5 ampères showed a change of reading of only 0·2 per cent. when the frequency was increased or decreased by 10 per cent.,

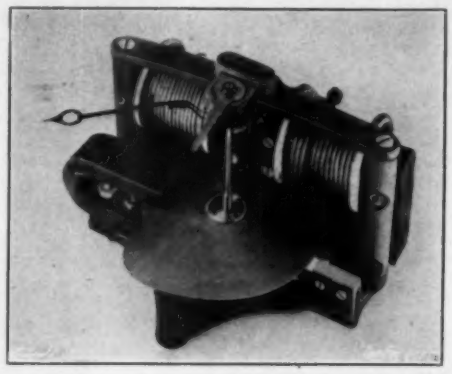

FIG. 34—INDUCTION AMMETER—EVERETT EDGCUMBE

whilst a change of temperature of 10 deg. also changed the reading by only 0·2 per cent. The instruments have a scale which is almost evenly divided from one-tenths of the maximum scale value upwards, and they are perfectly dead beat. The firm has also developed a line of low-current bar type current transformers in which nickel-iron alloy cores are used, and they are said to give quite remarkable results. For example, a 22-kV current transformer was exhibited. It is designed for a full-load current of 120 ampères, and has a ratio constant to within ½ per cent., and phase displacement of less than

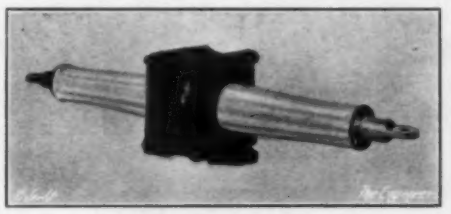

FIG. 35—CURRENT TRANSFORMER—EVERETT EDGCUMBE

1½ deg. at all primary currents down to 15 ampères. Where power measurements are not involved, and consequently where a phase displacement between the primary and secondary currents is unimportant, these current transformers are available for full-load currents as low as 20 ampères. An ammeter was shown giving a clear reading from 0·15 to 15 ampères, when working together with a super-sensitive over-current relay from a 20/1 bar type current transformer. An example of one of these transformers is shown in Fig. 35.

Voltmeters and wattmeters, giving precision

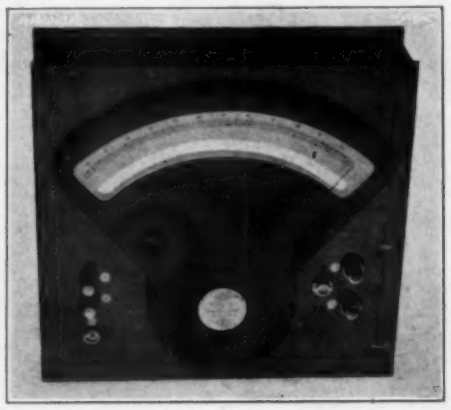

FIG. 36—LABORATORY WATTMETER—NALDER

accuracy to within one-tenth of 1 per cent. on direct-current and alternating-current circuits, have been developed by Nalder Brothers and Thompson, Ltd. In order to give a uniform scale a special movement is employed and the scale, which is 13¼in. long, has diagonal subdivisions. A precision wattmeter for laboratory use is shown in Fig. 36. First-grade induction type instruments were exhibited by this firm for the first time. A cylindrical rotor is acted upon by a rotating field, produced by two fluxes, displaced both in space direction and in time phase by approximately 90 deg. The main flux is produced by a primary coil placed on the external portion of the electro-magnet, whilst the quadrature flux is produced by a coil situated inside the rotor and fed by transformer action from the main coil. An ammeter constructed in this way will give accurate indications, irrespective of the frequency and the temperature of the surrounding air. The outstanding features of this new induction ammeter are:—(1) The temperature coefficient is less than 0·02 per cent. per degree Centigrade as against 0·4 per cent. per degree Centigrade in the older type of instrument; and (2) the frequency error is less than 0·2 per cent. for a rise or fall of 10 per cent. in frequency, as against 5 to 8 per cent. as compared with the older instruments. The momentary overload capacity is 5000 per cent. The firm also exhibited a new directional reverse

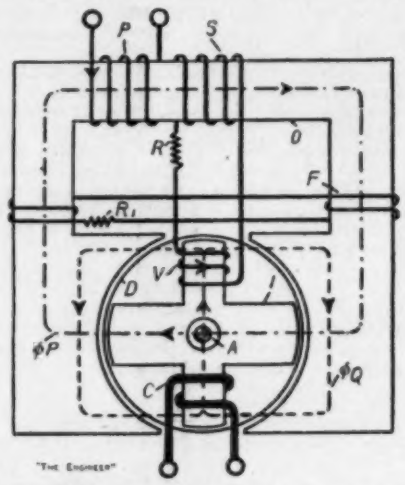

FIG. 37—REVERSE CURRENT RELAY CONNECTIONS—NALDER

current relay, the special features of which are that it is practically independent of the voltage of the controlled circuit and the volt-ampère consumption of the current winding is very small. The electrical and magnetic circuits of the current relay are diagrammatically illustrated in Fig. 37, where P is the main potential winding, C the main current winding, V the voltage compensating winding, F the power factor compensating windings, R and R^1 suitable resistances for calibration purposes. The coil V is energised inductively from the main potential winding and the coils F form a closed circuit of their own. The resultant potential flux φP circulates along the path indicated by the chain line, thus acting upon the rotor D in a horizontal direction, whilst the flux φQ, due partly to the current coil C and partly to coil V, acts upon the drum in a vertical direction, *i.e.*, at 90 geometrical degrees to that of φP.

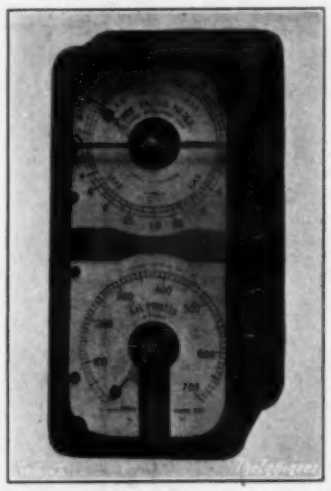

FIG. 38—COMBINED POWER FACTOR AND WATTMETER—NALDER

The resistance R^1 is adjusted so that the fluxes φP and φQ are also electrically displaced by 90 time-phase degrees. These conditions being satisfied, a turning moment is exerted upon the moving system by the combined action of fluxes φP and φQ. The polarity of the coils C and P is such that with forward power they tend to hold the moving system, and with it one of the relay contacts, against a stop in the inoperative position. On a reversal of power the tendency to rotate is in the opposite direction, and if the reversal reaches the value of the reverse current setting, the contacts will close and the relay will operate. The action of coil V is unidirectional and its effect is to assist or to oppose the current coil C according to whether the flow of current in the controlled circuit is in the forward or reverse direction respectively. It

follows, therefore, that at normal voltage the reversal will increase until it is sufficient to overcome the neutralising effect of coil V before the relay will operate. When, owing to a short circuit, the voltage drops the neutralising effect of coil V is correspondingly reduced and the relay thus becomes more sensitive. Matters are adjusted so that the energy required to operate the relay goes down proportionately with the voltage, so that the reverse current calibration, whatever the selected percentage value may be at normal voltage, remains practically constant for all voltages down to about one-fifth of the normal; hence the name—reverse current relay. The standard type "L.1 relay" is spring controlled and self-resetting. The current coil is wound for 5 ampères and the pressure coil for 110 volts 50 cycles. The V.A. consumption of the current coil is 1 at 5 ampères, and the V.A. consumption of the pressure coil is 4 at 110 volts 50 cycles. Unless otherwise specified, the relay is arranged to operate with a 15 per cent. reverse current at normal voltage and the contacts are arranged "to close" the trip circuit.

Another exhibit on this firm's stand was a combined power factor and induction wattmeter in a rectangular case measuring 5¼in. by 10¼in. This instrument is shown in Fig. 38.

Among the exhibits of the Brown-Firth research laboratories was a length of "H.R. Crown" steel wire, 0·22in. in diameter placed in the centre of an electric furnace, which raised the temperature to 800 deg. Cent. The wire was stressed by a load of 240 lb., equal to 3 tons per square inch. This steel has a maximum stress at 800 deg. Cent. of 20 tons per square inch, with an elongation of about 40 per cent. and, coupled with this high mechanical strength at high temperatures, is the property of resistance to oxidation in gaseous atmospheres. Samples of steel on the stand showed the relative oxidation of mild steel and

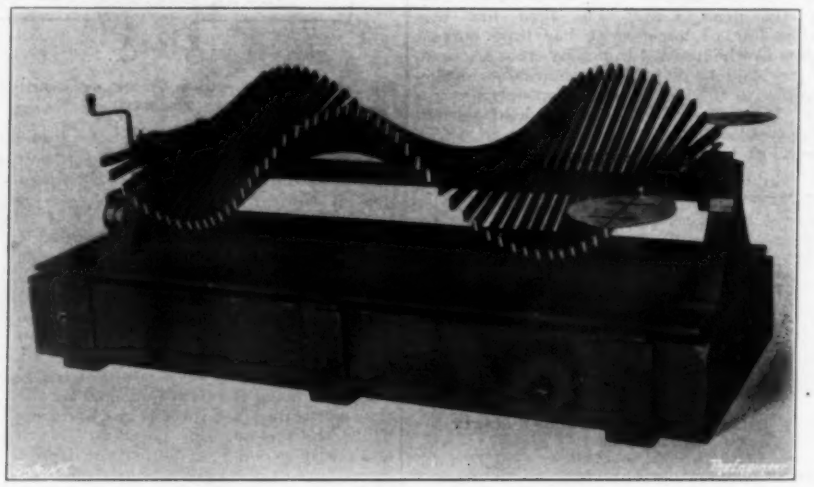

FIG. 39—VINYCOMB WAVE MODEL—GRIFFIN

of Firth "H.R. Crown" steel, the oxidation of the heat-resisting steel at temperatures up to 1000 deg. Cent. being practically negligible. A modern development in the non-corrodible steels has been the production of a super malleable "Staybrite" steel, and examples of cold pressings in this material showed remarkable capacity for plastic deformation. The steel is particularly suitable for use when maximum softness and ductility are desired. Photographs showed the many uses to which Firth stainless and "Staybrite" steels have been put, and how these steels have been adopted in the chemical, motor, general engineering and other industries. Spoons and forks in "Staybrite" steel attracted considerable attention.

The wave model—shown in Fig. 39—devised by Mr. T. B. Vinycomb, of the Woolwich Polytechnic, was exhibited by John Griffin and Sons, Ltd. It consists of laths pivoted on a common axis and connected by springs, so that when at rest they lie in a plane parallel to one another. If one of the laths be moved out of plane, the others follow the motion in turn, and a wave is thus propagated along the series. As the wave velocity is low, namely, a foot or so per second, the movements can easily be followed by the eye. All the characteristics of wave motion can be demonstrated for the apparatus gives a true wave propagated according to the laws of mechanics. With the aid of the model, the demonstration and discussion of the theory of all types of waves are simplified. At the end of the sets of laths there is a ball bearing which supports the tension of the springs and leaves the end lath free to rotate, thus giving the effect of a free or open end, but the end laths may also be clamped, so as to give the effect of a fixed or closed end. Moreover, at one end of the model the final lath can be attached to a flat spring of adjustable stiffness, and may also have air vanes fastened to it. The "impedance" of this end connection can thus be given a wide range of values, and the effect on the reflexion of waves can be plainly shown. A strong clockwork motor can be joined by a crank and connecting-rod to the lath at the other end, and by adjusting the speed of the motor this end can be given a simple harmonic motion over a wide range of frequencies. The velocity of propagation of the waves thus generated is independent of the frequency, until it is so great that the wave length covers about ten laths. Very high frequency vibrations are not propagated on the model as low-frequency vibrations are, but are passed on by a kind of diffusion of motion analogous to the conduction of heat. The model may be employed to illustrate wave motions met with in all branches of science, such as the general nature of progressive waves, sound waves, vibrations of springs and columns of air, water waves, longitudinal and torsional vibrations of rods and shafts, the propagation of currents along cables, high-frequency "cut off" on a loaded telephone line, reflexion of waves at a boundary, electrically "long" and "short" telephone lines, the general nature and origin of standing waves, phase change at reflexion dependent on boundary conditions, reflected and transmitted waves at the boundary of two media, and independent transmission of individual wave trains. If the initial displacement and velocity of each lath is given, the ensuing motion can be resolved into two wave trains moving in opposite directions with equal velocities. The possibilities of the model can best be shown by describing how some of these points can be demonstrated.

Phase Change at Reflexion.—In this case a single pulse is sent by hand from end to end, the reflected pulse then being direct or inverted, according to whether the other end is free or fixed.

Independence of Wave Trains.—Though two trains interfere to produce nodes and loops, neither is destroyed or changed. For this experiment, both ends should be fixed and a short train of, say, three waves started by hand in each direction from the centre, by moving the centre lath up and down three times. The reflected trains from the two ends then meet in the middle, interfere to produce standing waves, and pass on unaffected.

Standing Waves.—In this instance a continuous train of waves of any convenient frequency is set going by the motor. The reflected train interferes with this to produce nodes and loops. If the other end is fixed or free so that no energy is absorbed there, the two trains will be of equal amplitude, and there will be no appearance of a wave travelling in either direction.

Progressive Waves.—If the end lath is now connected to the spring and fitted with vanes, so as to absorb energy, the spring and vanes can be adjusted by trial, so that the incident wave is entirely absorbed and no reflexion takes place. The model then shows the progressive sine wave and all the characteristics of such a wave are easily observed.

Resonance.—If, when standing waves are being shown, the speed of the motor be adjusted until the driving end is a node, the waves gradually attain an amplitude much greater than that of the driver.

Sound Waves.—If the deviation of a lath from its equilibrium position be taken to represent the pressure in a medium transmitting sound waves, the propagation of the pressure is illustrated by the motion of the model. Similarly, the displacement of the lath transverse to the line of laths may be taken to represent the displacement of a particle longitudinally in a sound wave. The motions of the laths transversely follow the same laws as the longitudinal motion of the particles of the transmitting medium. The equation of motion is—

$$\frac{d^2y}{dt^2} = a^2 \frac{d^2y}{dx^2},$$

where a is a constant of the medium. Attenuation can be neglected, though present in the model.

Vibrations of Strings.—As a string under tension obeys the equation given above, with $a = \sqrt{\frac{T}{m}}$, the transverse vibrations of strings are shown in all particulars by the model. The motion of a piano string, in particular, is shown exactly by striking the laths at rest with the hand, the ends, of course, being clamped. The period of the vibrating string is seen to be the time for a wave to travel twice the length of the string. The various partials of a string with their nodes, &c., are shown by the model with the ends fixed. With a little practice the necessary motion can be imparted by hand.

Columns of Air, &c.—The motion of the air in a pipe with closed or open ends can be similarly shown if the transverse motion of the laths be taken to represent the longitudinal motion of the air, &c.

Torsional and Transverse Vibrations of Shafts, &c.—As the motion of the laths is really a torsional one about the wire axis, the torsional vibration of shafts can be demonstrated satisfactorily. The effect of local masses can be simulated by fastening loads on individual laths at the required positions.

Propagation of Currents along Cables.—Since the motion of the laths is subject to the same equation as that for the current in a cable—

$$P^2 \frac{d^2 I}{d n^2} = \frac{d^2 I}{d t^2}$$

where P is the propagation constant of the line, the behaviour of such a line can be demonstrated. Since the inertia of the laths is not uniformly distributed along the axis a change in the performance comes in when the frequency of the vibration is increased, so that there are ten or fewer laths per wave length. The inertia cannot then be treated as the equivalent of a continuous load. Similarly, the loading coils on a telephone line must be spaced so that there are at least ten to the wave length for the highest frequency to be transmitted. The attenuation of higher frequencies is very great and cannot be neglected in the model.

Long and Short Telephone Lines.—The effect of the receiving end apparatus on the transmitting end

FIG. 40—"TOROID" H.F. TRANSFORMER—DUBILIER

current vanishes in long lines, and in short lines it can be eliminated by balancing the impedance of the line at the receiving end. This is shown on the model by the formation of standing waves by reflexion unless the receiving end has its "admittance" (spring) and "resistance" (vanes) adjusted to balance the "line impedance" of the laths.

Many things of interest to users of wireless apparatus were shown by the Dubilier Condenser Company, Ltd. The Dubilier "Toroid," shown in Fig. 40, is a special type of high-frequency transformer suitable for coupling high-frequency stages of an amplifier or for aerial coupling of a radio receiver and for other purposes, that involve coupling two radio frequency circuits. The use of these transformers eliminates the necessity for providing metallic shields between the stages of a radio frequency amplifier, and owing to the absence of stray magnetic fields the neutralisation of the inter-valve reaction becomes simple. If a solenoid or open coil be bent into a circle and current be passed through the coil, it will be found that the electro-magnetic field will be confined very largely within the physical limits of the windings, although the bending of the coil results in a certain amount of separation of the turns and the consequent leakage of lines of force. In the construction of these "Toroids," however, the coil is wound on a spiral machine which eliminates the gaps between the turns, the effect being that the coil cannot exert any appreciable influence on any other coil or piece of metal near to it. By providing a few primary turns on the core the device can be made to act as a high-frequency transformer. If the primary be connected in the aerial and earth circuit of a receiver

and the secondary be tuned by a variable condenser, an efficient coupler or tuner will be obtained. Selectivity is superior to that obtained with an ordinary fixed coil and a variable condenser, whilst if a Dubilier "K C" condenser be employed for tuning the secondary, true kilo-cycle tuning is obtained. When employed as a high-frequency transformer, these "Toroids" are claimed to offer several advantages. Owing to the manner in which the field of the secondary coil is concentrated within the coil, a primary winding of but a few turns is sufficient to afford a high voltage step-up ratio, whilst as the secondary winding is composed of a single layer of wire, it has a low self-capacity. Two or more of these "Toroids" can be mounted close together in a radio set without causing instability by interacting upon one another, and they do not give rise to eddy currents in surrounding metal work. Moreover, as there is no need to screen these "Toroids" with metal shields, as commonly used with high-frequency transformers, the eddy current losses which these shields introduce are eliminated. It is also claimed that these "Toroids" are not directly affected by powerful oscillations which may emanate from a nearby transmitting station. Two ranges of "Toroids" are made, one for a wave length range of from 230 m. to 600 m. and the other for a range of 750 m. to 2000 m. When they are used to give more than one stage of high-frequency amplification, some method of neutralisation is necessary, and the makers supply tapped models for both of the wave length ranges. When used in conjunction with the firm's "K C" condenser—shown in Fig. 41—these "Toroids" are said to give true straight-line frequency tuning. The main dial of these condensers moves the vanes direct, whilst the upper part of the knob transmits the motion through a friction drive

FIG. 41—VARIABLE CONDENSER—DUBILIER

and moves the vanes slowly, the reduction ratio being about 200 to 1.

Another firm exhibiting wireless goods was the Igranic Electric Company, Ltd., which showed a very comprehensive range of components and complete receivers for reception on wave lengths from 10 m. upwards. The company's triple honeycomb coils and "Xllos" coils were on view. There were also short wave coils, a new geared coil holder, and variable condensers of different types. A condenser of special interest was the firm's "Lokvane" square law variable condenser, which derives its name from the ingenious method of mounting the vanes so as to enable them to be locked in position with absolute rigidity, and to provide for perfect electrical connection between them. The firm's newly designed micro-condensers and vernier balancing condensers form very useful accessories for incorporating in receivers with neutralised high-frequency stages. A neat and compact high-frequency choke, which is said to give very good results on wave lengths up to 3000 m., was shown. Among the Igranic components for low-frequency amplifiers was a new low-frequency transformer, with two ratios, viz., 3·6 : 1 and 7·2 : 1, which is claimed to give remarkably uniform amplification at all audible frequencies. The Igranic low-frequency choke and the firm's wound shielded resistor form efficient substitutes for those who select choke capacity or resistance capacity coupling, in preference to transformer coupling. The Igranic Neutro-regenerative short-wave amplifier kit, with certain additional components, enables a short-wave receiver to be constructed capable of giving short-wave high-frequency amplification on wave lengths as low as 15 m. The Igranic seven-valve super-heterodyne receiver outfit contains a high-frequency unit, oscillator unit and a complete screened intermediate frequency unit for building an efficient seven-valve supersonic heterodyne receiver. The Igranic-Pacent-Phonovox gramophone pick-up and amplifiers for the electrical reproduction of gramophone records created great interest.

There are many applications in industry for which it is necessary to keep the temperature of a process under close observation, and for which it is important to ensure that any appreciable deviation from the correct temperature may be detected. The Cambridge temperature deviation indicators, made by the Cambridge Instrument Company, enable deviations of temperature from any desired value to be easily and quickly observed. Instead of showing the actual temperature which is being measured, the instrument is arranged to show the difference between the measured temperature and a standard "zero" value, which represents the desired temperature for the process under observation. The indicator dial

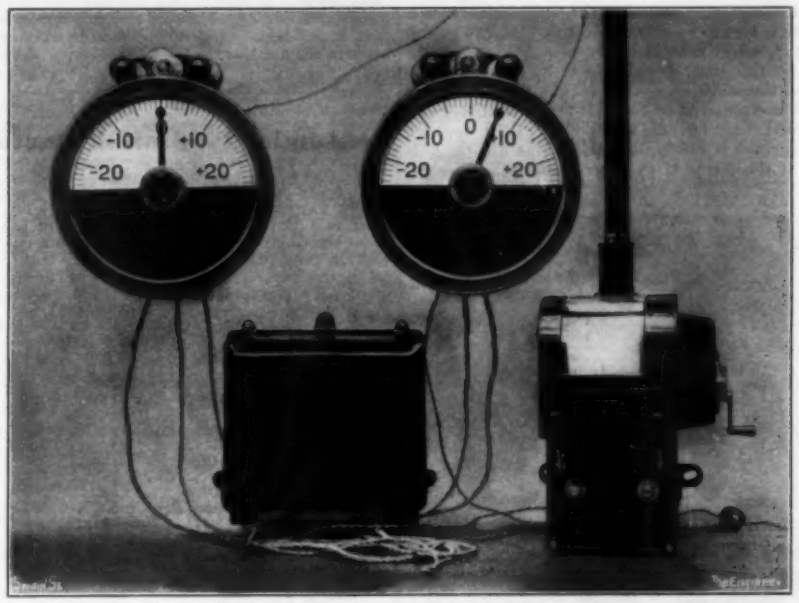

FIG. 42—TEMPERATURE DEVIATION INDICATORS—CAMBRIDGE

is marked in large and clear graduations from — 25 deg. Cent. through zero to + 25 deg. Cent.—see Fig. 42. The zero division on the dial corresponds to the temperature indicated on a scale engraved at the centre of the dial, and can be set to any value within the range of the instrument by rotating a small knob, thus moving a pointer over the scale, which may be graduated for any desired range up to 600 deg. Cent. The deviation is also indicated approximately by means of green, white and red lamps mounted on the top of the instrument. These lamps are auto-

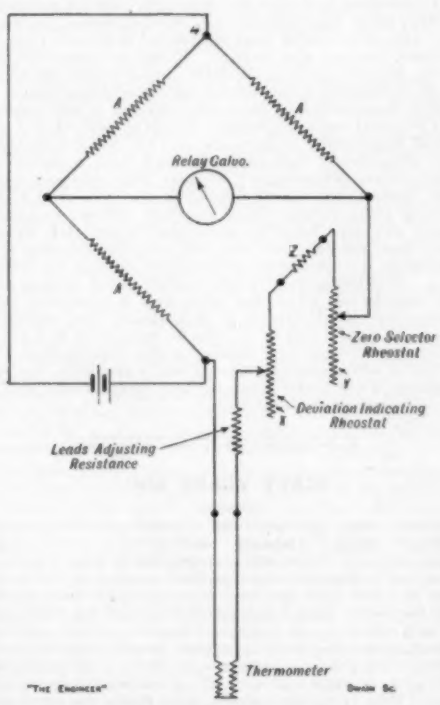

FIG. 43—TEMPERATURE DEVIATION SYSTEM—CAMBRIDGE

matically illuminated as the pointer moves along the deviation scale; that is to say, the green lamp is alight when the deviation is between — 25 deg. and — 4 deg. Cent., both green and white lamps are alight between — 4 deg. and — 2 deg. Cent., the white lamp is alight between — 2 deg. and + 2 deg. Cent., the white and red lamps are alight between + 2 deg. and + 4 deg. Cent., and the red lamp alone between + 4 deg. and + 25 deg. Cent. In this way it is possible to see at a glance from a distance whether the correct temperature is being maintained, and also the direction and approximate amount of any variations which may occur. The actual temperature is measured by means of a platinum resistance thermometer, comprising a coil of platinum wire wrapped round a porcelain bobbin. This bobbin, which is protected by a suitable sheath, is exposed to the temperature being controlled and connected to the indicator by leads. Referring to the diagram, Fig. 43, the platinum thermometer coil, together with two rheostats X and Y, form one arm of a Wheatstone bridge, the other part A being equal and made of wire which does not alter in resistance with changes in temperature. Both rheostats X and Y are carried within the indicator case.

The position of the slider on the rheostat Y, which determines the "zero" temperature from which deviation is measured, is controlled by the knob on the face of the indicator. The contact on the rheostat X is rigidly attached to the pointer of the indicator. The resistance Z is adjusted so that the total resistance of the fourth arm of the bridge is equal to A when the thermometer is at the temperature indicated on the zero selector scale and the pointer of the indicator is at zero. Under these conditions no current flows through the relay galvanometer. The galvanometer does not form part of the indicating instrument, but is a separate unit which may be mounted some

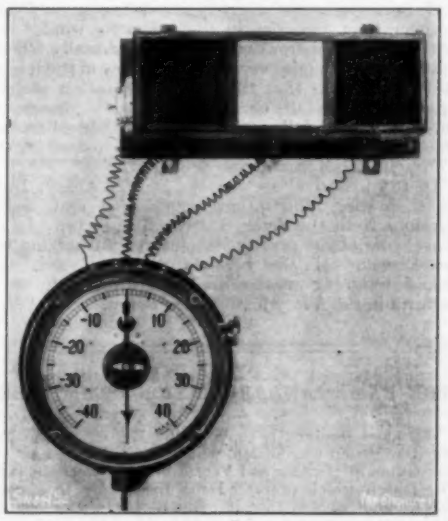

FIG. 44—TEMPERATURE INDICATOR—NEGRETTI

distance away. It can be arranged to operate a number of separate indicators, being connected to each in turn for a definite period by means of an automatic switch. A standard thread recorder can be added to the outfit, the platinum resistance thermometer for the recorder being then mounted, together with the indicating thermometer, within a single protecting sheath. Indicators of a design similar to that described can be arranged to work with thermo-couples and Féry telescopes for higher temperatures, up to 1700 deg. Cent.

Several things of interest were exhibited by Negretti and Zambra. The dial thermometer shown in Fig. 44 is provided with a signalling device which shows a white light when the desired temperature is attained, whilst if the temperature falls below the correct value a green light is shown, and a red light

when the temperature exceeds the correct value. The particular instrument illustrated has a range from 390 deg. to 470 deg. Cent., and the dial of the indicating instrument ranges from minus 40 deg. to plus 40 deg. Cent. The correct working temperature is attained when the pointer is at the zero position. The contacts to be seen on the centre of the dial causes the red, green and white lights to appear in accordance with the position of the pointer. The thermometer is a mollified form of the Negretti and Zambra 8in. mercury in steel distance thermometer. Another of Negretti and Zambra's exhibits was the surface thermometer shown in Fig. 45. The most accurate method of measuring the temperature of a hot surface is to rivet a thermo-couple element to the surface, but, when that is impracticable, reasonably accurate results may be obtained by pressing the couple on the surface. The surface thermometer illustrated is composed of two flat strips of dissimilar metal joined together at the point where contact with the surface is made, and the strips are bent in the form of the letter U to lessen conduction errors.

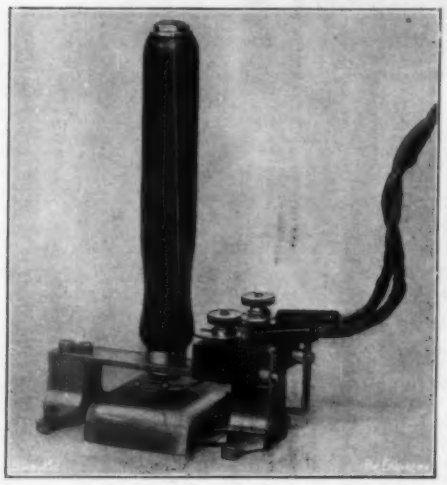

FIG. 45—SURFACE THERMOMETER—NEGRETTI

A polished reflector surrounds the thermo-couple to prevent loss by air currents, and by means of compensated leads the couple is connected to a portable millivolt meter calibrated in terms of temperature. The couple is pressed on to the surface by means of the handle to be seen in the illustration.

In the research and experimental section Mr. G. L. Addenbrooke showed apparatus for demonstrating splashes on the surface of a liquid dielectric produced by a point electrode with an intermittent field. The splashes are due to ions of like sign to the electrode. These ions are strongly repelled and falling on the surface cause indentations in it. When in sufficient number they give rise to the "electric wind," but are then too numerous to be seen individually. Their united pressure, however, forms a hollow in the liquid. It would appear that the tingling sensation when a brush discharge falls on the skin is due to showers of these ions. A full account of Mr. Addenbrooke's researches in this connection will be found in the *Philosophical Magazine* for May, 1927.

In the historical section W. and T. Avery, Ltd., were showing illustrations, specimens and reproductions from the Avery historical museum. In all there were about twenty-six pictures illustrating the development of the balance, the steelyard, and linked weighing mechanisms, all reproductions of pictures in the Avery historical museum.

THE FAN STANDARDISATION COMMITTEE.

WE have received a copy of the Report of the Fan Standardisation Committee, which was appointed by the Institution of Heating and Ventilating Engineers in 1922. The reason which prompted the Institution to appoint this Committee was that it realised that affairs relating (*a*) to the terms used in fan work; (*b*) to the methods of testing fans; (*c*) to the instruments used in connection therewith; and (*d*) to the information given in makers' catalogues were in an extremely unsatisfactory state, and the Committee was instructed thoroughly to investigate the whole subject and to report thereon. The members composing the Committee included representatives of (1) makers of fans; (2) large users of fans; (3) the British Admiralty; (4) H.M. Office of Works; and (5) the National Physical Laboratory. During the five years since its appointment some sixty meetings of the Committee were held, and a considerable amount of experimental work was carried out. The present report embodies the results of these deliberations and experiments and it has been adopted unanimously by all the members of the Committee.

It is divided into eight sections as follows:—I.: Definitions relating to fans; II.: Definitions and terms relating to fan performance; III.: Notes on instruments for measuring air pressures and velocities; IV.: Determination of the average velocity and the volume per minute of air flowing along a duct of more than 36 square inches cross-sectional area; V.: Methods of fan testing; VI.: Tolerances; VII.: Performance curves; and VIII.: Method of listing fans.

The subject is dealt with clearly and concisely, and, where necessary, simple illustrations are inserted in the text, and a notable effort has been made to place the whole matter—which is of an admittedly difficult nature—on a substantial and standardised basis. Many of the terms hitherto used have been discarded because their unsuitability led to confusion. In their places new terms have been introduced which, it is hoped, will prove serviceable and become standardised. Furthermore, the methods of testing proposed have been very carefully considered from every point of view and the Committee expresses its belief that they will give results satisfactory alike to manufacturers and users. If that end has been achieved—and from our study of the report it seems not at all unlikely that it has been—then a considerable advance has been made as the result of the labours of the Committee.

Admiralty Staff Reduction.

IN a "Journal" note in our last issue, we referred briefly to the Select Committee's report on Admiralty Staff and Expenditure. We are now in a position to place before our readers in tabular form a comparison of various departments of the Admiralty staff to-day and before the war. The following table has accordingly been prepared. The total staff is divided roughly into two sections—Administrative and Non-technical, and Technical.

	1927–28. Numbers.	1914–15. Numbers.	Increase, per cent. Numbers.
Administrative and non-technical—			
Board of Admiralty	11	10	10
Naval Assistants	15	5	200
Naval Staff, including "Air"	127	60	111
Naval Attaches	15	8	88
Naval Equipment Dept.	12	7	71
Naval Reserve Dept.	16	18	11
Physical Training Dept.	3	—	—
Medical Department	30	25	20
Naval *Personnel* Dept.	3	—	—
Chaplain of Fleet	2	2	—
Wireless Telegraphy Board	3	—	—
Account-General Dept.	610	353	73
Secretary's Dept.	136	119	14
Record, &c., Dept.	277	—	—
Naval Store Dept.	152	83	83
Contract Dept.	178	95	87
Dockyard Expense Dept.	36	21	71
Victualling Dept.	53	42	26
Office-keepers, &c.	377	335	12
Technical Departments—			
Naval Engineering	78	67	16
Naval Armament	288	114	152
Signals	15	—	—
Naval Construction	215	191	12
Civil Engineering	162	126	28
Electrical Engineering	102	26	292
Dockyard	74	44	68

The table is based on information extracted from the Navy Estimates of 1927 and 1914–15. New departments—*e.g.*, the Mobilisation, League of Nations, Paymaster-Director-General and Statistics Department—which had no counterpart in the pre-war Admiralty, are not included. Certain other departments—*e.g.*, Hydrographic, Compass and Education—have been transferred from one Vote to another, and are also omitted. Totals are therefore not given, but the figures in the table appear to provide a fair basis of comparison for certain individual departments.

The departments of particular interest to our readers will be found under Technical. It will be noticed that the Naval Engineering Department and the Naval Construction Department have only increased their numbers by very modest percentages; whereas large increases have been made in the Naval Armament and Electrical Engineering Departments. It is therefore difficult to understand why the Naval Construction Department should have been selected from the Technical Departments and named by the Committee as especially suitable for reduction. This Department is responsible for all designs and the construction of all new ships, and is intimately concerned with all alterations to ships afloat. If a reduction has to be made—and we express no opinion on that point—it appears logical and reasonable that departments, the duties of which are less onerous and responsible but the numbers of which have increased very substantially, should receive primary consideration.

SIXTY YEARS AGO.

SIXTY years ago, with the depredations of the Confederate vessel "Alabama" still fresh in their minds, some people in this country, among whom were ourselves, were not without anxiety regarding the state of the Navy. For the new fleet first-rate ironclads were being built, but they were being constructed in limited numbers, and, in any event, it was recognised that while they could be relied upon effectively to oppose similar vessels on an enemy's side, they would not serve well for the protection of our long coast line and of our extensive commercial fleet. That being the position, some alarm was expressed at the policy of the Admiralty in disposing of the wooden vessels of the steam fleet before we had a sufficient number of new vessels to take their place round our coast and on the trade routes. In many cases alarm was combined with annoyance, for it seems that in its anxiety to disencumber itself of the old wooden steamships, the Admiralty was accepting prices so low as to open the door to suggestions of underhand dealing. Writing on this subject in our issue of January 24th, 1868, we recorded that the "Colossus" and the "Collingwood," two noble examples of what was so lately our proud fleet, had been sacrificed at, we gather, a prodigal price. Such vessels, with their three decks and ninety guns were, we admitted, not required to repel corvettes, light frigates and privateers; but, we argued, they could readily be adapted to render immense service against guerilla attacks in maritime warfare by cutting them down. Freed from their upper decks and heavy armament and plated, if at all, to resist only the smaller calibres of naval guns, they could carry more coal and a smaller number of more effective guns, and would become almost exactly the class of vessel of which we stood in need. One important advantage of the plan, we continued, would be that it would enable us to throw into any naval war such a number of vessels possessing merits for a particular kind of fighting as no other nation could, for the time being, send ships to cope with. It was doubtful if there remained afloat elsewhere than in our own reserves, half as many good sound ships of the old first-class as those which we could send to sea in a few months. It had previously been proposed that the old wooden vessels should be cut down and converted into block ships. Either course, we held, was preferable to the preposterous practice of simply giving the vessels away in one or two favoured quarters for about the value of their nails. That policy would end in leaving us practically without a new fleet, while we sold the old one for a song.

MANCHESTER ASSOCIATION OF ENGINEERS.

THE annual dinner of this society was held at the Midland Hotel, Manchester, on Friday, January 20th, Mr. S. H. Heywood, President, being in the chair. There was a very fair attendance of members and friends. There were only two toasts besides that of "The King." The first toast, the "Manchester Association of Engineers," was proposed by Sir W. Peter Rylands, in a very interesting speech. He referred to what he described as the one great problem which confronted engineers. The coal trade to-day was suffering from an excess of capacity—a capacity far greater than the demand—but there could be no doubt that in another hundred years the difficulty of winning coal would be greatly increased, and if the industrial prosperity of Great Britain was to be maintained, some method would have to be discovered for producing a cheaper "form of power" or for the easier winning of coal. One of the problems for the engineer was how to provide some cheap substitute for coal and some cheap method of carrying on our industries. There were plenty of fields for the young engineers to conquer. In spite of the prevalence of bad trade in the staple industries of the country, a large amount of money was being spent. We were up against foreign competition which it seemed impossible to meet. As a nation, we were much too found of decrying ourselves. More confidence was required, but there was no lack of enterprise and ability. The depressed state of our industries was an ill for which an economic and not an engineering remedy had to be found. In replying to the toast, the President appealed to the members of the Association for greater support, and specially commended the work of the students' section. The toast, "Our Guests," was proposed by Mr. G. E. Windeler, M.I. Mech. E., and was responded to by Mr. W. E. Thompson, President of the Manchester Chamber of Commerce, who paid a compliment to Sir Benjamin Longbottom for the work he was doing as chairman of the engineering section of the Chamber.

NEW CHILIAN TORPEDO-BOAT DESTROYERS.

ON Wednesday last, January 25th, there was launched from the Woolston Yard of John I. Thornycroft and Co., Ltd., at Southampton, the first of six ocean-going torpedo destroyers for the Chilian Navy. It will be recalled that this order, which is one of the largest ever placed for destroyers, and the first naval order of any note placed by a foreign country since the war, was secured by Messrs. Thornycroft in May last in the face of world competition. The boat launched on Wednesday was the "Serrano," which was named by Madame Huneeus, the wife of Señor Don Antonio Huneeus, the Chilian Minister to Great Britain. Three other destroyers are on the stocks, and a fourth will be laid down on the slipway vacated by the "Serrano." The principal dimensions of the new ships are as follows:—Length overall, 300ft.; beam, 29ft.; maximum draught, about 12ft. 8in.; with a fully loaded displacement of about 1430 tons. The guaranteed speed is 35 knots, and the propelling machinery comprises twin-screw compound geared turbines and geared cruising turbines. The main high-pressure turbines are of the Brown-Curtiss type, with low-pressure Parsons cylinders. Steam will be raised in 250 lb. pressure oil-fired Thornycroft water-tube boilers, with seamless cylindrical lower drums. The main armament includes three 4·7in. guns, one 3in. anti-aircraft gun, two triple 21in. torpedo tubes, and a powerful anti-submarine armament.

At the luncheon which followed the launching ceremony, Sir John E. Thornycroft referred to the general machinery arrangement of the vessel, which, he stated, was generally similar to that of the "Amazon," which his firm had built for the British Navy, and which had served very successfully in service. In order to ensure a minimum cost of upkeep and long life, the shell plating of the new vessels were galvanised, and heavy scantlings were employed in the hull, which would give low stresses. The sea-keeping qualities of the new ships had been given careful consideration, and no attempt would be made to sacrifice them, even though the utmost possible speed under trial conditions would be attained. The new design of machinery would give increased economy and improved radius of action. Sir John stated that the work entailed in the Chilian contract would suffice to provide employment for some 2000 men in Southampton alone for a period of about two years.

ONE of the features of the Morden extension of the London Electric Railway to which we drew attention when the line was opened in September, 1926, was the provision by the railway company of a garage at Morden wherein the business man resident in that area could leave his car during the day. That has been so successful that six more bays, to accommodate a further fifty cars, are to be added.

Railway Matters.

IN this column on September 9th we mentioned that the London, Midland and Scottish new 4–6–0 engines of the "Royal Scot" class were to be given names. The intimation has now been made that the first twenty-four are to be named after famous regiments.

THE exhibition of famous locomotives for public inspection is decidedly popular. The "Royal Scot" of the London, Midland and Scottish Railway has not only been visited by over 100,000 persons, but the small sum charged has brought in £2500 for charity.

MENTION has from time to time been made in this column as to the provision by the London, Midland and Scottish Railway of automatic signals between Campbell-road Junction, Bow-road, and Barking, mainly in order to allow for the Metropolitan District Company to increase its train service up to, if necessary, forty trains per hour. It is now officially announced that the work will be completed by the end of February, and that on March 5th additional trains will commence to run.

A CONFERENCE of local authorities, presided over by Sir Alexander Stevenson, the Lord Provost of Edinburgh, was held in that city on January 18th to consider the proposals of the railway companies as to transport by road. Whilst the resolution passed did not indicate any violent opposition to those proposals, it was recommended that the authorities petition against the draft orders, and that the companies be approached as to what provision they were prepared to make for the protection of local authorities.

THE extension of the Charing Cross, Euston and Hampstead Railway to Waterloo and Kennington has led to a great increase in the traffic at Charing Cross, where 10,000 more passengers use the station than did a year ago. So great is the increase that it is expected that instead of the 35 millions a year dealt with there to-day, accommodation must be provided for 50 millions annually. Considered improvements are therefore being made, including additional and more convenient escalators. The booking office at the street level is to be reconstructed, and will extend practically the whole length of the District Railway platforms.

IT is announced that Westminster City Council has approved the continuation for a further three months of the experiments by the Ministry of Transport with traffic light signals in Piccadilly. The Commissioner of Police requires a further period to decide whether these signals are of any real use. As we have been interested in this adaptation of railway signals to road traffic movements we have frequently watched the operation of these signals. Rarely, we find, do their indications coincide with the movements being made, and, as yet, we have not seen the yellow indication, that is to warn drivers that a change to "stop" or to "move" is about to be made, used at all.

THE Ministry of Transport railway statistics for last October have recently been published as a Stationery Office publication, price 3s. 6d. They show a decrease, when compared with October, 1925, of 5·8 per cent. in the number of passenger journeys and a fall of no less than 9·2 per cent. in the receipts from passengers. The passenger train mileage was little changed—an increase of only 0·2 per cent. The goods traffic, moreover, did not give the same good results as had been experienced earlier in the year. The tonnage decreased by 1·9 per cent., and, in spite of the increase in rates in February, 1927, the receipts only rose by 1·6 per cent. The ton-miles decreased by 2·7 per cent., but there was a decrease of only 1·2 per cent. in the freight train miles.

THE five railway companies interested in road transport have now issued a public statement in justification of their application for powers to own and work road transport services. As the statement has been fully reported in the daily newspapers, we do not think there is any necessity to enlarge thereon. The following paragraph may, however, be quoted as showing how the public and the traders, as well as railway shareholders and employees, are affected: "The Railways Act, 1921, is designed to secure to the railway companies a definite net revenue, and any losses sustained by railway companies in consequence of unfair road competition therefore fall to be borne by the traders and the public who continue to use the railway. The maintenance of the railway companies' standard revenue is essential if additional capital is to be available for the purpose of developing and improving railway undertakings to serve modern requirements. This subject of fair and equitable conditions of road and rail competition is therefore a matter of vital concern to the public and the traders, who must continue to rely mainly on the railway system for the transport requirements, as well as to the railway shareholders and employees."

IN the unusually early spell of fog in the first week of last October there were three collisions, of sufficient importance to call for investigation by the Ministry of Transport. One of them occurred on Wednesday evening, October 5th, between Welsh Harp and Brent Junction No. 1 signal-boxes on the former Midland Railway. A goods train stood on the up fast line at the latter box waiting for admission into the reception sidings, and there is no doubt that the distant signal for Brent No. 1 box was "on," and as it controlled the inner and outer distants for Welsh Harp box, they also were in the "on" position. An express from Manchester followed the goods train and the home signal at Welsh Harp and the corresponding inner and outer distants were all against it. The fireman, unfortunately, did not know the road sufficiently to be of real service to the driver in the dense fog that prevailed, and the latter was misled into believing that the two distants were "off." Moreover, although the fog-signalman had been sent for he had not arrived to take up duty at the outer distant signal—which was the key signal for all the signals to Cricklewood. The driver was warned by a detonator that Welsh Harp home signal was at "danger," but he failed to pull up in the 546 yards thence to the standing goods train. There was no serious personal or material damage. In his report Colonel Sir John Pringle points out that the accident would have been prevented altogether had automatic train control existed.

Notes and Memoranda.

THE total world consumption of electric lamps is of the order of 600 millions. Of this amount about one-twentieth is used in this country.

IT is stated that by changing the terminus of the Hudson Bay Railway from Port Nelson to Fort Churchill, a saving of 17,700,000 dollars can be effected.

COUNTRY lands in Victoria artificially supplied with water for domestic and ordinary use and for watering stock, comprise about 23,188 square miles, or about 14,840,000 acres, according to the report of the Water Supply Commission for the year 1926–27. The area under irrigated culture for all kinds of crops in the year was 406,532 acres, the largest yet recorded.

PROTECTION against lightning on electrical circuits entering a mine is a feature that is sometimes overlooked, states the American Bureau of Mines. Lightning has been known to go underground on power wires. The Bureau has learned of one instance where lightning travelled at least 3000ft. underground. In this case it was stopped by a well-grounded switchboard and oil switchcases, and did not damage the motor generator sets. The possibility of such damage is another reason for using good ground connections wherever possible.

THE earliest recorded use of wood blocks for the purpose of paving roads is believed to have been in Russia. The first blocks consisted of short uniform lengths, round in shape, as cut from the tree trunk. Later, to secure a closer joint, these became hexagon in shape, and finally received their present form of rectangular blocks as cut from the deal to a uniform width and depth, and were laid in courses. This method of paving was first introduced in England about 1838, but some time elapsed before the value of a firm foundation, such as Portland cement concrete, was adequately appreciated.

A DEMONSTRATION of the Alexanderson television system similar to that given a few months ago, but on an enlarged scale, was conducted by the General Electric Company, of Schenectady, on January 15th. Television receivers were installed in the homes of several of the company's officials, enabling experts and newspaper men to witness reception in different localities. According to reports, the experiments were quite successful. The image was received by each instrument on a screen 3in. square, the figure of a man being plainly discernible, even cigarette smoke being visible. Speech was transmitted at the same time, and was received on load-speakers incorporated in the television sets.

A FEW days ago the Bell Telephone Company successfully demonstrated a new loud speaker which has been designed to enable people within a mile radius to hear public addresses or music. It is believed that a million people may thus be reached at the same time. The apparatus was demonstrated by connecting a field telephone on the west bank of the Hudson River with the reproducing instrument on the east bank. Everything said or sung into the telephone came back perfectly clear and without distortion, like an echo, and the assembled witnesses were much amused by the astonishment of the river pilots who heard their names called out in the quietness of a Sunday morning.

THE following are some developments which have taken place or are proposed in the establishment of new works in Australia:—The proposed establishment of a whisky distillery and the manufacture of gin by the Distillers Company, Ltd., of Scotland; the proposed establishment of tire works by the Goodyear Tyre Company of America and the Rapson Tyre Company of England; the establishment, with the assistance of the Tasmanian Government, of artificial silk works in Tasmania by an Italian concern; the erection of assembling shops in the various States by the General Motors Corporation of America; the establishment of cotton mills in Victoria for the manufacture of towelling and other cotton goods by Australian enterprises; a proposal by another prominent British firm to erect cotton mills in Australia; the proposal to proceed with the erection of paper pulp mills in Tasmania; the reconstruction of the Australian Linoleum Manufacturing Company of Australia, to proceed with the production of linoleum; the erection of a power alcohol plant in Queensland by a combination of sugar growers with the Distillers Company of Scotland; a proposal by an American concern to erect cotton mills in New South Wales; the proposal by an Australian concern in agreement with the New South Wales Government to erect a blast-furnace and rolling mills at Port Kembla; and a proposal by the Australian Glass Company to start sheet glass making.

THE Electricity Commissioners are at present engaged in reviewing their existing codes of regulations for securing the safety of the public, with the object of effecting a revision thereof, and in this connection have given special consideration to the possible consequences of the failure of cables insulated with bitumen and laid in wood casings, especially in the case of direct-current systems. In June last the Commissioners caused an inquiry to be held on their behalf by Mr. G. Scott Ram, M.I.E.E., and Dr. J. S. Haldane, F.R.S., into the matter of an explosion which occurred at Acton with resultant loss of life and destruction of property, and the report of the inspectors was subsequently published. The views expressed by the inspectors have been carefully considered by the Commissioners, and, pending a decision as to the amendment of the existing regulations, the Commissioners consider it desirable to acquaint authorised undertakers with their broad conclusions, namely:—(*a*) That all services into consumers' premises should either be laid solid or taken into the premises in such other manner as to prevent any influx of gas at the point of entry; and (*b*) that there should be a frequent and regular testing of cables laid in bitumen, and also inspection where accessible, particularly in the case of cables which carry direct current and have been in use for a number of years. In the opinion of the Commissioners it is also advisable, notwithstanding the importance of continuity of supply, that station and substation attendants should be given reasonable discretion in the matter of switching off circuits in the case of a heavy fault where cables laid in bitumen are known to be involved.

Miscellanea.

THE Canadian Post Office Department has, it is understood, formulated plans for the construction of a new postal terminal at Montreal which will cost about 2,000,000 dollars.

A CONTRACT has been arranged for the supply of 52 million units of electric energy, from the Grampian Electricity Supply Company, for distribution by the Central Electricity Board to the South of Perth.

THE capital cost of the proposed new works on various Victorian outer ports will be:—Gippsland Lakes, £250,000; Welshpool, £80,000; Warrnambool, £300,000; Port Fairy, £100,000; Portland (immediately), £10,000; total, £740,000.

AT the ordinary meeting of the Institution of Electrical Engineers, to be held on Thursday, February 2nd, at 6 p.m., a portrait in oils of Mr. Ll. B. Atkinson, Past-President, I.E.E., will be formally presented to the Institution by the Cable Makers' Association. The portrait was painted by G. Harcourt, R.A.

THE Southern Railway Company has placed with William Denny and Brothers, Ltd., of Dumbarton, an order for another motor vessel, similar to the motor car ferry "Fishbourne," which Messrs. Denny built last year for service between Portsmouth and the Isle of Wight. The "Fishbourne" is a twin-screw vessel of 136 tons gross, with Gardner engines of 240 horse-power and twin propellers at either end. It was described in THE ENGINEER of July 22nd, 1927.

As a result of a meeting held at the Central Hall, Westminster, it is proposed to form an engineering council for the London and district area on lines similar to the one carried on at Manchester. The Council will be open to all sections of the engineering industry—employers, trade union leaders, managers, foremen, draughtsmen, clerical staff, and men from the workshops—its objects being:—(1) To provide facilities for personal intercourse between employers and workers; (2) to furnish opportunities for general discussion; and (3) to carry out investigation and study of the conditions and problems affecting the working of the engineering industry, and formulate constructive proposals.

AN important extension of the Transatlantic Telephone Service to the Continent of Europe was recently made, when the service was opened between the whole of the United States and Cuba on the one hand and Brussels and Antwerp on the other hand. Conversation to America from Belgium passes over the Anglo-Belgian cables to the London trunk exchange, and thence by land line to the Rugby Wireless Station. Speech from the United States to Europe is received by wireless at Cupar in Scotland, passes by land lines to the London Trunk Exchange, and thence *viâ* the Anglo-Continental Telephone Cables. It is reported that extensions of this service to other European countries are planned to take place shortly.

ACCORDING to reports from Port Lincoln a race to Falmouth *viâ* Cape Horn began on January 19th between the four-masted barques "Herzogin Cecile" and "Beatrice," the former carrying 51,409 bags of wheat and the latter 37,015 bags. These will be the first ships to reach England with this season's grain, and a stirring contest is expected between two of the speediest sailing ships afloat. The captains enthusiastically took up the challenge. The "Beatrice" started six hours in advance, but the captain agreed not to make full sail until both vessels were level. The race, a rare event among wheat ships, is reminiscent of the lively rivalry of the tea and wool clipper days, and is exciting keen interest. Each ship has a complement of twenty-six boys.

AN exhibition indicating the possible utilisation of Overseas Empire timbers in industry will be held at the Exhibition Pavilion of the Imperial Institute, South Kensington, on February 3rd–April 30th. This Exhibition is the second of a series arranged to direct attention to specific resources of the Empire, with the object of increasing the usage of Empire raw materials in Great Britain. Samples of selected timbers from some of the Dominions and Colonies will be shown in conjunction with the articles which can be made from them. An important feature will consist of exhibits illustrating the work carried out at the Imperial Forestry Institute, University of Oxford; the Forest Products Research Laboratory (Department of Scientific and Industrial Research) at Princes Risborough; and at the Imperial Institute.

A SCHEME for the further education of boys and youths engaged in rolling mills in Birmingham has been approved by the associated manufacturers in the non-ferrous metal trades. Although not compulsory, it is provided that all boys (over fourteen and under seventeen) and youths (over seventeen and under twenty) should attend classes at the evening institutes, and in certain cases at the technical colleges. It is also proposed to arrange a special course in metallurgy at the Central Technical College, provided sufficient students are forthcoming. Students will pay the usual fees, but these will be refunded by the employers' committee to all those who attain a certain standard of attendance and proficiency. In addition to refunding class fees the employers' committee offers prizes for attendance and home work.

A NEW high-compression engine, said to effect a fuel-saving of at least 25 per cent., has been invented, built and tested by Mr. O. W. Hult, the inventor of the Swedish "Archimedes" detachable motor boat engine. The principle employed is that the efficiency of an engine is greatly increased if the cylinder can be supplied with gas at a low temperature at a low pressure. This effect Mr. Hult has obtained by adding an extra cylinder block, in which the gas is first compressed, the heat of compression being eliminated, and then allowed to expand before being fed into the cylinder of the motor. A compression of about 9·6 kilos. per square centimetre is obtained, instead of 6·5 as in the ordinary petrol motor. During the tests the new motor has been shown to reduce the petrol consumption from 280 grammes per horse-power hour to 192 grammes, and in a new four-cylinder motor, now being built, the inventor hopes to obtain an even greater saving of fuel.

THE DUNSTABLE PORTLAND CEMENT WORKS

MESSRS. MAXTED AND KNOTT, WESTMINSTER, ENGINEERS

(*For description see page* 92)

FIG. 6—STEAM DIGGER QUARRYING CHALK

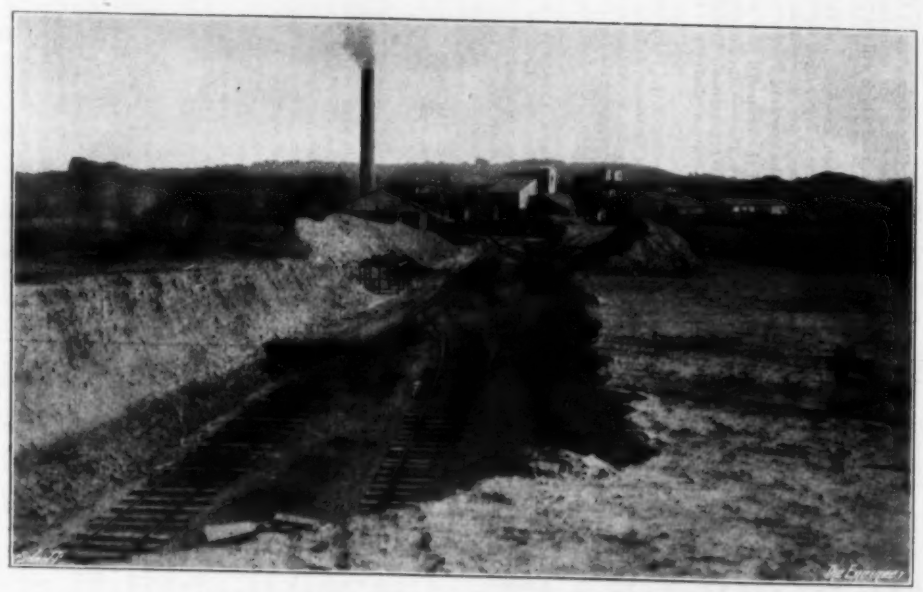

FIG. 7—GENERAL VIEW OF WORKS FROM CHALK QUARRY

FIG. 8—BATTERY OF SLURRY SEPARATORS

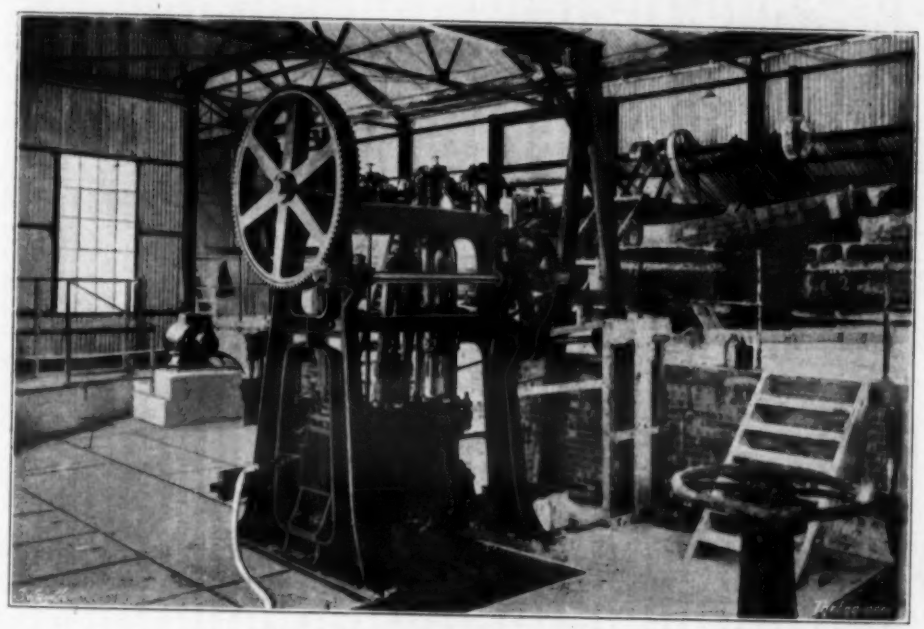

FIG. 9—THREE-THROW SLURRY FORCE PUMP

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† M. 605		
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† Fr. 390	PARIS : Berger Leverault, 229, Bld. St.	
	Germain	
	PARIS : Brentano's, 37, Av. de l'Opera	
	PARIS : Dunod, 92, Rue Bonaparte	
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* R. mks. 70·00	S.W. 48	
† R. mks. 65·00	WESTERN GERMANY : Fritz Rehfus, Blumen-	
	thalstrasse 10, Cologne	
	LEIPZIG : K. W. Hiersemann, Konigstrasse 29	
HOLLAND ..	ROTTERDAM : Hector's Boekhandel, Noord-	
* Fl. 41·00	blaak 59	
† Fl. 38·00	ROTTERDAM : Techn. Boekhandel, "Plan C,"	
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SIXTEEN-PAGE SUPPLEMENT.—"THE METALLURGIST."

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The Metallurgist

THE JANUARY NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

THE ENGINEER.

JANUARY 27, 1928.

The Efficiency of Steam Nozzles.

THE presentation of the fifth report of the Steam Nozzles Research Committee last Friday evening at a thinly attended meeting of the Institution of Mechanical Engineers passed off, as usual, without serious criticism being evoked. As usual, too, the majority of those taking part in the discussion were members of the Committee or were associated with the experimental side of its work. Of the remaining four speakers, three represented British firms engaged in the manufacture of steam turbines, and from them there fell nothing but high testimony to the direct practical value of the Committee's investigations. Are we to conclude from these facts that the Committee's work is of no interest outside a narrow circle, and that it is altogether above and beyond criticism ? Can the average engineer, interested in prime movers, but unconnected with the Committee or with the manufacture of steam turbines, find no pertinent question to ask, no helpful remark to make, concerning the Committee's studies ? Is the art of debate so dead among the modern generation of engineers that they are incapable of discussing any subject lying outside their own particular branch of the profession ? We cannot believe that the absence of helpful outside interest and criticism which has marked the reception of all the Committee's reports so far is to be traced to the lack of general interest and grounds for criticism in the reports. Reviewing all that the Committee has published concerning its activities up to the present, we find abundant room for legitimate questioning and much that is, or ought to be, of wide moment to the general engineer from the educational point of view, if from no other.

Among the more striking questions which have never, so far as we can recall, been put to the Committee is why it should be necessary to go to the great trouble and expense that have been incurred with the object of improving the efficiency of steam nozzles. Of all the sources of loss of energy in a steam turbine plant, that arising from the inefficiency of the nozzles is about the smallest and, to the uninitiated, the least important. Designed even in accordance with the rules and practice established before the Committee set to work, the nozzles are responsible for a loss which seems almost insignificant compared with the heat passed to waste in the boiler flue gases or thrown away in the exhaust steam. The nozzles experimented upon by the Committee have so far mainly been of an admittedly out-of-date, non-commercial form, which modern practice can, with assurance, claim to be capable of excelling. Yet even with those nozzles the Committee has repeatedly registered efficiencies as high as 95 per cent. and over. It could, therefore, be argued that the efficiency of steam nozzles is already so high that it is not worth while going to great labour to improve it. Would it not, then, it might be asked, be much more profitable to devote attention to the other sources of loss where the maximum possible improvement that might be effected is very much greater ? An important consideration would appear to strengthen the reasonableness of these questions. The Committee measures the efficiency of its nozzles by comparing the kinetic energy of the steam on the inlet side with the kinetic energy on the outlet side. The inefficiency of a nozzle is therefore a measure of the kinetic energy lost by the steam flowing through it. It is obvious that that loss is, by its nature, not of the same kind as the loss represented by the elevated temperature of the flue gases or of the condensing water. The bulk of the lost kinetic energy, as much, we believe, as 90 per cent. at times, is converted into heat which passes on with the steam and which is available in the lower stages of the expansion. The loss is not a total loss ; practically all of it reappears as heat in the steam, and, except in the lower stages of the expansion where the energy which reappears as heat may escape incompletely utilised into the condenser, it would almost seem that the inefficiency of the nozzles is not a matter of first-class importance to the overall thermal efficiency of the plant. Quite apart from this consideration, it might be argued that the efficiency of the nozzles is only one of a chain of factors determining the overall efficiency of the plant. To what extent or proportion does a given improvement in the nozzle efficiency produce an improvement in the overall efficiency ? That is a question which, we believe, the Committee has yet to answer, and it is one which we think the general engineer might well ask. It is scarcely possible that a rise of, say, five points in the nozzle efficiency will effect a rise of five points in the overall efficiency figure, although it must not be forgotten that an improvement in the nozzle efficiency is applicable not only to the first set of nozzles or blades, but to all the nozzles or blades throughout the turbine. Turning to another aspect of the Committee's work, it might be asked to what extent there are grounds for believing that a nozzle of given pattern, which under given conditions shows a certain efficiency in the Committee's testing apparatus, will have a similar efficiency in an actual turbine. It is difficult to believe that any exact correspondence can prevail, at least in all cases. Three or four blades or partition plates fixed in an orifice in a box can be at best but a poor representation, for example, of blading held only at the ends and projecting radially from the periphery of a disc or cylinder. Again, we have it on excellent authority that the results obtained from the tester are extraordinarily susceptible to minute variations in its construction, not only as regards the exact form and position of the nozzle box, but as regards the design of the cage, the pressure plate, and the chamber within which the whole is housed. We are, we think, safe in saying that the tester is not capable of giving absolute measurements of the efficiency of steam nozzles, and that all the care and skill that have been spent on its construction have been expended solely with the object of securing an apparatus that could be relied upon to give strictly comparable relative efficiency values.

The value of the Committee's work, in spite of questions such as those which we have outlined, cannot be doubted. Were we really inclined to subject it to hostile criticism, we would be checked by the generous tributes to its usefulness that have been paid by many people engaged in the practical design and manufacture of steam turbines. The only criticism which we have heard

from such people is the complaint that the Committee is not publishing its results sufficiently quickly to keep pace with the requirements of modern turbine development. Were the tributes of the manufacturers insufficient to check our criticism, we would feel constrained to silence by the knowledge that at least two firms building steam turbines have sought to secure patent rights to themselves for applications of certain facts revealed in the Committee's reports. The truth of the position, so far as we can discover it, is that the practical turbine builder is in considerable ignorance regarding the efficiency of his nozzles and blades when in position in the turbine. At the present moment he is well content if he can discover which of two forms is the better, and to that end the relative nature of the results yielded by the Committee's tester, or by any other form of similar apparatus that can be trusted to give consistent readings, is sufficient for his purpose. Equally, too, would he be well satisfied with a definite assurance that of two forms of nozzle one would yield an improvement in the overall thermal efficiency of one or two points. He is not rapacious enough or foolish enough to expect a 10 per cent. improvement in the overall figure by anything which he might do to the nozzles. One or two per cent. will, in actual fact, bring him a reward that will be well worth securing. It is not a question by any means solely of reduced coal consumption, but is largely concerned with capital expenditure. We have it on the authority of a well-known designer of turbines that an improvement of 1 per cent. in the thermal efficiency of a 20,000 kW turbine would economise capital expenditure to an amount of the order of £4000. The actual coal saving, in a turbine of that size, on an average load factor would amount to at least 450 tons a year. When we consider that in some stations plant of 200,000 kW capacity and over is installed, it will be appreciated that an improvement of but 1 per cent. in the overall thermal efficiency of the station is of very considerable significance, both from the point of view of capital expenditure and running expenses.

Automatic Train Control.

THE question of so controlling trains that, in the event of a driver over-running his signals the train would automatically be pulled up, has been so little in evidence of recent years that it will come as a surprise to most people to hear that another Departmental Committee has been appointed to consider the matter. When the activities of the Ministry of Transport were at their highest, an opportunity presented itself to investigate this question as a means of preventing a repetition of the many collisions which had occurred through drivers ignoring adverse signals. During the war period alone there had been, among such accidents, those at Ilford and Smithy Bridge in 1915 and at Warminster, Wigan and Kirkpatrick in 1916. After them came the serious collision on July 17th, 1920, at Lostock Junction, which would appear to have brought the matter to a head, as, in the following October, a Departmental Committee was appointed to consider the question. The Committee reported on April 20th, 1922, and the report was published on June 21st, and reviewed in THE ENGINEER of the 30th of that month. The opinion was expressed that automatic train control was the only reliable method of preventing a large proportion of the class of accident referred to and that a case for the installation of train control on British railways had been made out. In view of what we say later, it is important to note that the Committee added that it considered that the system likely to prove most suitable would be of the contact type, *i.e.*, a shoe on the locomotive to make contact with a ramp between the rails, and that the system should be common to all lines. Towards the attainment of the latter end it was further recommended that the railway companies should forthwith form a committee of experts to determine and standardise track and locomotive apparatus, having regard to differences in structure and loading gauges and the position of conductor rails on electrified railways.

Since the report was published little has been heard of the matter. From Sir John Pringle's annual report on railway accidents for 1922 it seems that the recommendations had been referred to a technical committee, but not until Sir John's report for 1926 was issued in September last was it recorded that that body had made any progress. Meanwhile, in the annual report for 1923 it was stated that three of the collisions inquired into during that year would have been prevented had automatic train control been in operation. In 1924 the number of such accidents was only two. That satisfactory state of affairs having been continued through 1925—when, again, there were only two cases—it was not surprising to find Sir John saying in his report for that year that, in view of that record, the case for the adoption of automatic train control, regarded from the point of view of safety, was less urgent in character than when considered by the 1922 Committee. Furthermore, if the financial position of the companies was considered, it did not appear that the expenditure which would be necessary could justifiably be called for at that moment. He added that at the same time it was most desirable that the railway companies' committee of experts should continue its examination of the question, in order that a decision should be arrived at on the standard form of control most suitable for adoption at any future date, when circumstances were more propitious. Then came the report for 1926, which went even further. The number of collisions was then only three, and Sir John—with, we consider, commendable frankness—said that it could not be held that the case for the adoption of train control was stronger than in 1925; justification for calling upon the companies to incur the expenditure was still lacking. He then proceeded to say that it appeared, as a result of examination of the general question by the technical committee, that great difficulties would be experienced in selecting one standard form of control of the type recommended, owing to variations of under-clearances.

In view of the foregoing record as to accidents, it may be surprising that the question is again being considered. The reason is not, we suggest, to be found in any increase in the number of collisions or in any particular collision, but in the conclusions, mentioned above, of the committee of experts. Since the earlier Committee reported in 1922, great progress has been made in the United States, where automatic train control was made compulsory under the Transportation Act, 1920, and the consequent Order of June, 1922, of the Interstate Commerce Commission. It has there been found that induction systems are superior to the contact type, especially because of the climatic conditions in winter, and that "radio" presents hopeful possibilities. Hence, no doubt, the announcement of the Ministry of Transport that the new Committee is to study non-contact systems. Another reason is the difficulty of deciding upon a contact system that can be universally adopted, especially in view of the use of conductor rails for electrical propulsion. The latter fact, no doubt, explains the presence of a representative from the Metropolitan Railway on a committee in whose work the main line companies are more generally concerned.

Literature.

Coal in Great Britain. By WALCOT GIBSON, D.Sc., F.R.S. (L. and E.). London: Edward Arnold and Co. Price 21s. net.

THIS book, which now appears in a revised edition, is probably the only treatise of the kind published in this country. In it the author endeavours to present to his readers an important subject in a compact, lucid and useful manner. The major portion of the book is practically a reproduction of its predecessor, which was published in 1920, and in consequence there are omissions of greater or less moment. In view of recent research and publications, Chapter V., "Fossils as Zonal Indices," for example, is disappointing, and the absence of references to recent literature throughout the work is regrettable. Mention of a modern method of bore-hole surveying would have added to the value of the chapter on prospecting and boring. In these days very few mining engineers would put down a trial shaft when boring can be done both expeditiously and cheaply.

The author states that "in this country the maximum depth at which coal is considered workable is 4000ft." One should hesitate to put any limit to the depth at which coal can be worked. If the Geothermic Gradient is regarded as the controlling factor, some system of cooling the air might be adopted similar to that at Morro Velho Mine, Brazil, where the workings extend to a depth of 6400ft. below the surface and 3650ft. below sea level. Again, 1ft. is quoted as the minimum thickness at which coal may be worked at a profit. That was the figure adopted by the Royal Commissioners in their calculation in the report on Coal Supply for 1905, but it must be accepted with hesitation when present-day costs are considered. Chapter XII., "The East Kent Coalfield," would certainly be enhanced by the inclusion of some of the important data that have been published since the appearance of the first edition. The three revised chapters dealing with the coalfields of North Staffordshire, Yorkshire and Nottingham are good.

In the excellent re-written chapter on the Scottish coalfield, the author refers on page 279 to the fact that "no great physical break accompanies the startling change in fish and plant life." Among geologists no such physical break of great magnitude is postulated at the present day, as there is no hiatus in the development of the truly marine vertebrates and invertebrates. The author's inclusion of the new chapter on the origin and composition of British coalfields is a valuable supplement to this commendable work, which the reviewer has no hesitation in strongly recommending as a valuable addition to the library of those interested in one of the greatest, if not, indeed, the greatest of our national products.

BOOKS RECEIVED.

Le Port de Lisbonne. Lisbon: Administraçao Geral do Porto de Lisboa.

The Grey Book, 1928. London: The Institute of Journalists, 2-4, Tudor-street, E.C. 4.

Annales des Travaux Publics de Belgique, 1927. 6me Fascicule, Décembre. Brussels: Goemaere, rue de la Limite, 21.

The "Motor Ship" Reference Book, 1928. London: The Temple Press, Ltd., 5-15, Rosebery-avenue, E.C. 1. Price 5s. net.

The People's Year Book, 1928. Manchester: The Co-operative Press Agency, 118, Corporation-street. Price 3s. and 2s. net.

Modern Coal-washing Practice. By R. C. R. Minikin. London: Ernest Benn, Ltd., Bouverie House, Fleet-street, E.C. 4. Price 45s. net.

Railway Signalling. By S. T. Dutton. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 7s. 6d. net.

Wireless Principles and Practice. By L. S. Palmer. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 10s. net.

"Mechanical World" Electrical Pocket Book, 1928. London: Emmott and Co., Ltd., 20, Bedford-street, W.C. 2. Price 1s. 6d. net.

Handbook on the Practice of County Courts. By J. E. Spickett. London: Jordan and Son, Ltd., 116, Chancery-lane, W.C. 2. Price 7s. 6d. net.

Diesel Engine Design. Third edition. By H. F. P. Purday. London: Constable and Company, Ltd., 10, Orange-street, W.C. 2. Price 21s. net.

Cours d'Electricité Théorique. Volume II. By J.-B. Pomey. Paris (VIe): Gauthier-Villars et Cie., 55, Quai des Grands Augustins. Price 100f. net.

The Estimation of Firedamp. By C. S. W. Grice and D. W. Woodhead. London: His Majesty's Stationery Office, Adastral House, W.C. 2. Price 1s. net.

The Concrete Year Book, 1928. Edited by Oscar Faber and H. L. Childe. London: Concrete Publications, Ltd., 20, Dartmouth-street, S.W. 1. Price 3s. 6d. net.

Rivure et Soudure des Chaudières à Vapeur. By E. Hoehn. Paris (VIe): Librairie Polytechnique Ch. Béranger, 15, Rue des Saints Pères. Price 28f. net.

Cours de Mécanique, Complément Résistance du Béton Armé. By L. Guillot. Paris (VIe): Librairie Polytechnic Ch. Béranger, 15, Rue des Saints Pères. Price 24f. net.

Marine Engineering in Theory and Practice. Volume II., Applied. By S. G. Wheeler. London: Crosby Lockwood and Son, Stationers' Hall-court, E.C. 4. Price 35s. net.

Factory Organisation. By C. H. Northcott, O. Shelden, J. W. Wardropper, and L. Urwick. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 7s. 6d. net.

Report on the Conditions and Prospects of British Trade in India, 1926–1927. By T. M. Ainscough. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 4s. net.

Die Einflüsse bewegter Lasten auf Brücken und Das Problem der Radreibung. By Ing. A. Buchwald. Vienna: Gewerbliche Druck- und Verlags-Anstalt G.m.b.H., Mariahilfer-Gürtel 14, Vienna VI. Price 3·30 marks.

Report of the Proceedings of the Fourth Conference of the Association of Special Libraries and Information Bureaux. London: The Association of Special Libraries and Information Bureaux, 38, Bloomsbury-square, W.C. 1. Price 10s. net.

Forschungshefte der Studiengesellschaft für Höchstspannungsanlagen; Kathodenoszillograph. Edited by Professor A. Matthias. Berlin: Derlag der Vereinigung der Elektrizitätswerke E.V., Willhelmstrasse 37, S.W. 48. Price 12 marks.

Les Turbines à Vapeur. Volume I., Théorie et Calcul des Turbines à Vapeur; Volume II., Les Turbines à Vapeur. By Ing. G. Belluzzo, translated into French by J. Chevrier. Paris (VIe): Gauthier-Villars et Cie., 55, Quai des Grandes Augustins. Price: Volume I., 60f.; Volume II., 80f. net.

The Water Supply of Towns and the Construction of Waterworks. Two Volumes. Fourth edition. Volume I., *Collection and Purification Works.* Volume II., *Works for Distribution.* By W. K. Burton and J. E. Dumbleton. London: Crosby Lockwood and Son, 7, Stationers' Hall, court, E.C. 4. Price 25s. per volume.

ABOUT 1000 motor trucks are in use in Shanghai for commercial purposes, 80 per cent. in the International Settlement and 20 per cent. in the French Concession. The trucks are mainly American, British and French.

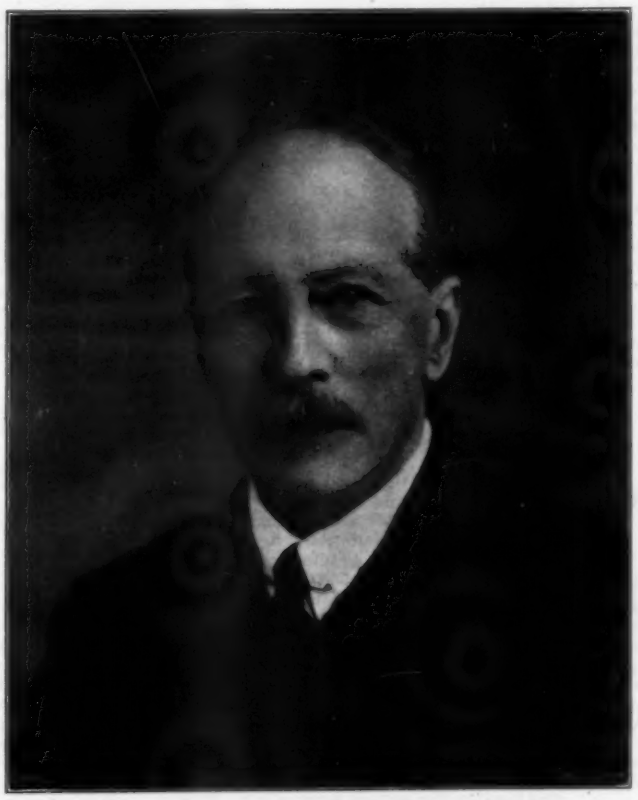
Obituary.

MICHAEL LONGRIDGE.

THE engineering profession has lost a very distinguished member by the death of Mr. Michael Longridge, which took place at Exeter on Wednesday, the 18th inst.

Michael Longridge, who was born in 1847 and was therefore in his eighty-first year at the time of his death, came of a line of engineers all celebrated in their way. First of all, his father, James Atkinson Longridge, M. Inst. C.E., who had learned his profession of civil engineer under George Stephenson, was not only noted for his work as the surveyor and constructor of railways in this country, on the Continent and further abroad, but his name is also identified with the invention of the method of making wire-wound guns, which was employed by Woolwich and Armstrong's right up to the end of the war. Again, his grandfather, another Michael, was a contemporary and close friend of George Stephenson. He was an ironmaster at the Bedlington Ironworks, and had much to do with the introduction of malleable iron rails on railways in the early part of the nineteenth century—before the advent of the locomotive. Finally, his uncle, the late Mr. R. B. Longridge, was the eminent chief engineer and manager of what was originally the Boiler Insurance and Steam Power Company of Manchester. It is small wonder then that, being of such lineage, the younger Michael should himself have become an engineer of high repute.

He began well. At Radley College, where he received his early education, he gained the Richards Gold Medal, and the Ouseley Prize in music. Then he went to Trinity College, Cambridge, and, in the Mathematical Tripos of 1869, he had a place among the Senior Optimes. Thereafter, for the next five or six years, he worked with his father on the location and construction of railways and other operations in different parts of the Continent. First of all he was engaged on the Fell Railway on Mont Cenis; then on the survey of a line to connect Terni with Ceprano, in Italy. A year later he was helping to build what eventually became part of the Swedish Central Railway, being in charge of one section of that undertaking. He must have done his work well in that position, for when his task on the line was completed he was appointed to superintend, in England, the design and construction of permanent way material—including bridges—and rolling stock for it, and also for another Swedish enterprise—the Oxelösund Fleu Railway. But he was not concerned solely with railway work; canal and irrigation engineering claimed some part of his time, and, in addition to France, Italy, and Sweden, he was called upon to visit Hungary to report on various works.



MICHAEL LONGRIDGE

August, 1875—when he was twenty-eight years old—marked a turning point in his career. His uncle, Mr. R. B. Longridge, offered him a position in a newly formed department of what was then known as the Boiler Insurance and Steam Power Company. The new department was to concern itself with the insurance against breakdown of steam engines. Young Michael accepted the offer—though it meant severing connection with his father's business and entering upon an entirely new sphere of activities—and went to Manchester. As a matter of fact, matters did not turn out very well shortly after he had done so. It was discovered that the original company had no power to undertake the new line of business, and, for a time at any rate, it had to be given up. Apparently, however, Michael still remained with his uncle, and some three years later, in 1878, a new company with the altered title of the Engine and Boiler Insurance Company was formed, and of it he became Chief Engineer. The name of the company was, later, again altered to its present designation, the British Engine, Boiler and Electrical Insurance Company, Ltd., and Mr. Longridge continued to hold the position of its Chief Engineer to the time of his death.

Of his work during the half-century which has elapsed since his appointment a very great deal might be written. At regular intervals he made, primarily for the information of his directors, most illuminating reports of what he had done and ascertained. Those reports, which remain as monuments of his tireless industry, bear testimony to the wide and varied scope of his abilities and attainments. He was always an earnest advocate of the necessity for improvement in the steam engine, and much of the advance in the efficiency of that prime mover, as achieved during the last couple of decades by makers in this country at any rate, can be attributed to him. The experiments that he made, the tests which he carried out, and the consummate accuracy with which all the arrangements connected with them were formulated and conducted, have rendered the results of his labours and discoveries classic, and of the utmost value to engine manufacturers and users alike.

As long ago as 1874 Mr. Longridge was made an Associate Member of the Institution of Civil Engineers, and he was transferred to the class of Full Member six years later. In 1880 he became a Member of the Institution of Mechanical Engineers, becoming a Vice-President of that body in 1903, and senior Vice-President in 1914. For that year the late Sir Frederick Donaldson, Superintendent of Woolwich Arsenal, was President. At the very moment when the summer meeting of the Institution was to be held in Paris industrial trouble broke out at Woolwich. Sir Frederick felt that he could not leave and the burden of carrying out the presidential duties was suddenly thrown upon Mr. Longridge. He rose to the occasion in an astonishing manner. Until that time a rather infrequent and not very ready speaker, he seemed, under the need of the moment, to give rein to an innate gift. He became eloquent, and made many admirable speeches in that peculiarly incisive manner that was particular to him. For the session 1916–17, when the country was plunged in war and he was doubly busy because war work was superimposed on his already heavily weighted shoulders, he was elected President. He not only undertook the heavy duties of that office, but to all intents and purposes he became the manager of the Institution. He had an office in the building and was in practically continuous session. What the Institution owes to him for his services during those trying years it is difficult to estimate. But it is his presidential address to the Institution, delivered on April 20th, 1917, in the lecture room of the Institution of Civil Engineers, that remains most vividly in the memory of all who heard it. It was one of the best that has ever been presented to the "Mechanicals." It stands out, not only as a masterpiece of prose—of how many presidential addresses can that be said?—but also as a human document evincing great delicacy of feeling. To read it gives a better insight into the character of the man than any words that we could write would give. It would, perhaps, be fitting, therefore, for our present purpose—the delineation of a life picture—for us to glance for a moment or two at some of the subjects that it covered.

Naturally, seeing the time that the address was prepared and delivered, there was, almost at the outset, a reference to the War. "The War," he said, "has taught us many things, but none more clearly, more insistently, than the importance of our Engineering Industry. Upon this industry we depend for victory to-day and prosperity to-morrow." Should that industry be wrested from us, he continued—as many industries had been during the past half-century—England would fall to the rank of a second-rate Power, and the British Empire would be dismembered. The War had made us realise the possibility of that great disaster and had brought home to us the need of action to avert it; and the need was urgent. "The victory we all pray for," he added, "may be won before my successor takes my place. Then we shall be plunged into a commercial struggle, and, unless we adopt my old school motto, 'sicut serpentes sicut columbæ'—'wise as serpents and gentle as doves'—into an industrial war also, both fiercer than any we have hitherto had to face."

Could any human prophecy have more accurately foretold the march of events? And on what did Mr. Longridge base his forecast? America, he showed, was rich beyond imagination, and was systematically preparing to capture the world's markets if she could. Germany, if reports were true, was organising her industrial resources in a way that we, with our strongly individualistic proclivities, could not hope to rival, and neutral nations were growing rich at the expense of those who were fighting for their future independence. It therefore behoved us to take stock of our position and to plan measures, not merely to hold our own, but to regain the pre-eminence which British manufacturers had lost.

That loss of pre-eminence was then examined in detail, and, finally, proposals were made as to how it might be regained. Into the reasons for the loss we cannot spare space to enter, and would say no more than that our manufacturers—in no matter what goods they deal—would most certainly do themselves no harm and might do the country much good were they to study carefully the whole of the address, of which we can here do no more than present a mere outline.

But what of the remedies? Some causes of our relative retrogression were, Mr. Longridge asserted, beyond the control of engineers; others they could remove in part or altogether. Of the latter, inefficient education, lack of trade organisation, and the policy of the trades unions, claimed special attention; and very outspoken attention they received from the President. But all was not destructive criticism; there were suggestions for improvement in the case of each. The whole tenour of the address was, while pointing out faults in no honeyed phrases, to show the way to that amelioration of affairs of which, evidently, he did not despair. Not only did he not despair, but he was even hopeful, as his peroration shows:—"Behind us are the dark days of the past, before us on the horizon is the new industrial world. Can we not turn our backs upon the night and march in faith, in hope, in charity, towards the dawn—the dawn of a new day, when England shall be Merrie England in the noblest sense, wherein employer and employed shall live in peace and work together for the glory of their native land?" His suggestions were all framed with the object of bringing about that most desirable state of affairs.

In addition to being President of the "Mechanicals," Mr. Longridge was elected President of the Manchester Association of Engineers in 1911. As regards his war work—for which he was made C.B.E. and which was once referred to by Sir Alexander Kennedy as being "responsible, difficult, and necessary, although sometimes thankless, . . . which only an experienced engineer could undertake"—he was appointed in 1915 to the panel of experts for examining inventions connected with munitions of war. He also served on the British Engineering Standards Committee, the General Board of the National Physical Laboratory, the Artificial Limbs Department of the Ministry of Pensions, and the Advisory Council of the South Kensington Museum.

CHARLES DAY.

THE death is announced as having taken place on the 19th inst. of Mr. Charles Day, whose name will be well known to many by reason of his long connection as an engineer in the service of Waygood-Otis, Ltd., in the manufacture and installation of lifts. Mr. Day was, in fact, connected with that company for nearly fifty years, having entered the service of R. Waygood and Co. in 1871. His father, the late Mr. J. M. Day, together with Mr. Henry C. Walker, the present chairman of the company, and

the late Mr. W. R. Green, purchased the business in 1875 from Mr. Richard Waygood, who founded it in 1833, and it was carried on by them for twelve years. Mr. Charles Day became a partner in 1887 and afterwards a director with the other partners, when the business of R. Waygood and Co. was formed into a limited liability company in 1894. The businesses of R. Waygood and Co., Ltd., and the Otis Elevator Company, Ltd., of London, were amalgamated in 1914 and the name changed to Waygood-Otis, Ltd., and Mr. Day continued to act as a director of that company until his retirement seven years ago.

GEORGE WASHINGTON GOETHALS.

WE regret to learn of the recent death of the great American engineer, Major-General Goethals, whose name will always be associated with the construction and completion of the Panama Canal. George Washington Goethals was born on June 29th, 1858, at Brooklyn, N.Y. He received his early education at the College of the City of New York, and graduated from West Point College in 1880. He then became attached to the Corps of Engineers and was employed on improvements to the channel of the Ohio River, near Louisville. After returning to West Point as a teacher, he rejoined Colonel W. E. Merrill's staff, and took part in river improvement work around Pittsburgh. His first large engineering task was the construction of the Muscle Shoals Canal on the Tennessee River, between the years 1891 and 1894, after which he was mainly employed on Army staff work until 1906, when President Roosevelt appointed him as chief engineer of the Panama Canal scheme. The important part which General Goethals played in the successful completion of that great undertaking is well known. After the opening of the Canal in the summer of 1914, Colonel Goethals, as he then was, became the first civil governor of the Canal Zone, and in 1915 he was made Major-General. In the following year, however, he resigned from that office, and, after becoming chairman of the Committee which was formed to report on the Adamson Eight-hour Law, he was appointed the State Engineer for New Jersey. For a brief period he was also associated with the Emergency Fleet Corporation, but between 1917 and 1919 he was chiefly employed in Army administrative duties. Major-General Goethals retired from Army service in March, 1919, and was subsequently occupied in the direction of a constructional engineering undertaking.

Institution of Mechanical Engineers.

NORTH-WESTERN BRANCH.

THERE was a very good attendance of members of the North-Western Branch of the Institution of Mechanical Engineers at a meeting held on Thursday, January 19th, at the Engineers' Club, when Mr. Lawford H. Fry presented his paper, already reprinted in our columns, on "Some Experimental Results from a Three-cylinder Compound Locomotive." Before the author was called upon to read his paper Mr. H. F. Massey, the retiring chairman of the branch, introduced the new chairman, Professor Watkinson, and the result of the ballot for the election of new members of the Committee was announced as follows:—Mr. J. Bissett, Mr. E. J. Christian, Professor Gibson, Dr. Morley, and Mr. W. E. W. Millington.

After Mr. Fry had read a *résumé* of his paper a vote of thanks was proposed by Professor Watkinson, who said he was greatly interested and pleased to see that water tubes were used in the fire-box. That, he thought, was an important step, especially if the pressures were to be greatly increased. Mr. Fry had referred to the action of the steam with variation of speed. The Chairman said he thought that Mr. Willans, in his experiments, had found that the greater the speed the less the proportional interchange of heat between the steam and the cylinder walls, which was, he understood, exactly opposite to what had been found in that case. He would like, he said, to ask Mr. Fry whether any secondary superheating had been tried between the high-pressure and the low-pressure cylinders. He imagined that that, in locomotive work, would give an advantage.

Sir Henry Fowler, President, in opening the discussion, said he was delighted to be able to say once more how indebted they were to Mr. Lawford Fry—he was speaking as a locomotive man and not as President—not only for the work he had done that evening, but for the work he had devoted his life to, and which he had always so readily placed at the disposal of those other engineers who were interested in the same subject. It seemed, perhaps, hard, but he was going to ask Mr. Fry some questions, in order to try and extract still more information from him. First, why did he think that a pressure of 500 lb. was as far as they should go? It was true that there was only one locomotive in England using that pressure at the present time. Elsewhere, however, there were locomotives which were working at very much higher pressures. He had had the opportunity some two months ago of riding on a locomotive in which the steam was used at a pressure of 900 lb. He had been very much surprised at the performance of that locomotive. Then again, the temperature of the steam used in the American engine was comparatively low—about 659 deg. Fah. On the Midland temperatures up to 800 deg. were used satisfactorily under certain conditions and 700 deg. was quite common. The fire-box casing was very interesting. Mr. Fry had not given any particulars with regard to thickness of the fire-brick, and he wondered whether that was a practical difficulty. He wondered, too, why the speed was limited to 200 revolutions per minute. He was speaking as a member of the Bridge Stress Committee which was sitting. That Committee looked upon that figure as extremely low. It was exceeded very materially by many large British engines on fairly long runs. Could Mr. Fry tell them what steel was used for the valves and for the boiler tubes? On the Schmidt locomotive a nickel steel was employed.

Mr. Gresley said that towards the end of his remarks Mr. Fry had referred to the desire for an accurate knowledge of steam action in locomotive cylinders. But we in this country were greatly handicapped and America had great advantages. He referred to the absence in this country of any means of obtaining such data as Mr. Fry had obtained and laid before them. We were greatly handicapped in not having a testing plant such as that at Altoona. The results obtained on the testing plant were substantiated in actual practice. It was obvious that on a dynamometer car one was quite unable to obtain data with regard to the action of the steam in the cylinders, which could be obtained in a stationary plant. Like Sir Henry, he had some questions to ask. He wanted to know why, in building that engine, the three-cylinder compound arrangement had been adopted. There were certain inherent disadvantages in the three-cylinder compound, amongst which was the intermittent draught. Another disadvantage attaching to one high-pressure cylinder was that it gave a less even flow to the receiver than two. Some of the cards in the booklet which Mr. Fry had sent to him on "No. 60,000"—not reproduced in the paper—indicated that there was a considerable amount of variation in the receiver pressure which might perhaps have been overcome had two high-pressure cylinders been used.

With regard to the cylinder ratios, Mr. Gresley said that Mr. Fry was dealing with a pressure of 350 lb. per square inch, and his cylinder ratios were 2 to 1. The same cylinder ratio had been used in England on compounds and was used on French engines with pressures of about 200 lb. to 220 lb. per square inch. Why did Mr. Fry give a ratio of 2 to 1? In the German engine to which Sir Henry had referred there was a ratio of about 5 to 1. Mr. Gresley said he thought that when they were getting a higher pressure the 2 to 1 ratio was not the best that might be adopted. Then again, "No. 60,000" was an experimental engine, and the cut-offs of the high and low-pressure cylinders had a fixed variation throughout—about 30 per cent. variation. He thought, for experimental purposes, it would have been an advantage if an independent gear had been used for the high-pressure cylinder, so that different ratios of cut-off could have been tried with a view to seeing which gave the best results.

Touching upon the question of low superheat, 600 deg. to 650 deg., Mr. Gresley said he thought that the reason why in America low superheat was used was because the engines were so big. It might sound rather ridiculous, but he had noticed that with small engines and small boilers higher superheat was obtained than with large boilers. Although the "Pacific" engines which he had produced on the London and North-Eastern had large superheaters for English practice, yet those engines had not given anything like as high a superheat as some of the engines with boilers about 10ft. long. American engines were, of course, a great deal longer. They had enormous superheaters, and yet they gave comparatively low superheat. On the L. and N.E.R. there were engines which had been running since before the war with balanced valves in which superheat of 800 deg. was being attained every day, and they had not given any trouble, even on such valves. In his latest boilers the number of elements had been increased from thirty-two to forty-three, which was about double the number that used to be regarded as satisfactory for English practice. With those superheaters a temperature of over 600 deg. and up to 650 deg. was reached, but not anything like the 750 deg. which he had hoped to get.

The boiler part of the paper was most interesting, because in a locomotive everything depended upon the boiler. He did not know that the fire-tube type of barrel with the water-tube type of fire-box was necessarily the best. He thought that it was quite possible to have a complete water-tube boiler on a locomotive. A disadvantage of a complete water-tube boiler which had been suggested was that there would not be a sufficient volume of boiling water in the boiler. It had been said that if there were small tubes and a very small quantity of water, there was but little to draw on to meet the variations of loads to which the locomotive was subjected. Yet with drums of 18in. diameter, it was possible to make a water-tube boiler which would contain practically as much water as the present type of locomotive. With a boiler of that kind a very much greater proportion of the heating surface of the boiler would be subjected to radiant heat, and practically none of the boiler, except the back part of the tubes, subjected to heat by convection. The size of the boiler could be reduced, because the evaporative capacity of the heated surface which was subjected to radiant heat was much greater than the evaporative capacity per square foot of tubes through which gases passed. Such a boiler would be much more suitable for burning oil or pulverised fuel.

Mr. Chambers said he had been particularly interested in the coal and water consumption given in the paper. Sir Henry Fowler had given, at the last meeting which Mr. Fry had attended at the Institution of Mechanical Engineers in London, a few particulars of the three-cylinder engine the "Royal Scot," and Mr. Chambers said he would like to compare those figures with the results obtained with the "No. 60,000" three-cylinder compound engine. The actual consumption of the latter when tested on the testing plant had been round about 2¼ lb. of coal per draw-bar horse-power per hour, and about 16 lb. of water, or just under. The "Royal Scot" engine, under running conditions, without having previously been tuned up, had given about 2·7 lb. of coal and 24 lb. of water. In Mr. Diamond's paper on the three-cylinder compound engine he had compared very closely the proportion of the work per draw-bar horse-power per hour and indicated horse-power per hour. On Mr. Diamond's figures, the "Royal Scot" gave approximately 17 lb. per draw-bar horse-power per hour of water and just under 2 lb. of coal. On the basis of those figures was Mr. Fry sufficiently satisfied with the figures he had obtained for "No. 60,000"? Mr. Fry gave some interesting diagrams which were based on what he called a special locomotive cycle. Mr. Chambers said that he knew that that comparison had caused a little bit of thought and concern among locomotive men who were closely concerned with analyses. He would like to ask Mr. Fry why, in every case under notice, he had taken a different locomotive cycle for comparison. That information, he was sure, would be very enlightening.

Mr. Shawcross agreed with Mr. Gresley in regretting that England had not got a testing plant. He wanted to ask Mr. Fry the reason for the high cut-offs in the high-pressure cylinder, and why the low-pressure cylinder was treated so meagrely? He had looked through the paper and had found that the receiver volume was about equal to that of the two low-pressure cylinders. The receiver volume seemed fairly big, and yet it was only used to the extent of 40 per cent., 50 per cent., and so on. Would it not have been much better if the high-pressure cut-offs had been 40 and the low-pressure cut-offs later? Would not very much longer expansions have been obtained and more value got out of the cylinder?

Mr. J. W. Smith asked what the cylinder clearance was in the high-pressure engine. That had been one of the troubles in designing the first three-cylinder engine. Clearances had been made rather low at first, and it had not been possible to get the designed speed. When the clearance was increased the speed was easily reached. Mr. Gresley had referred to using different gears—one for the low-pressure engine and one for the high-pressure engine. The first five engines built on the three-cylinder compound type had had that kind of gear, and it had been found that, in the hands of a driver who understood the engine, better results could be obtained by working in a proper manner than would have been obtained if there had only been one reversing gear for both engines. It had been proved conclusively by the engines built on the Midland that there was a great advantage in having separate gears.

Mr. Sanford asked, why not let the combustion take place in a chamber which could be lined with fire-brick? All that would happen would be that the temperature of the gases entering the tubes would be higher; but, according to curves given by Mr. Fry in THE ENGINEER some years ago, the heat absorption in a tube was so effective that one could very easily get down to the same final temperature. He did not see that the efficiency of the boiler would be impaired, and there would be the great advantage of not having water tubes to scale up and flat surfaces to give maintenance troubles.

Mr. Gass said that Mr. Fry was an advocate of large engines. He remembered some years ago making some tests on two locomotives, one having a tractive effort of 20,000 lb. at 80 per cent. of boiler pressure, and the other a tractive effort of 28,000 lb. Those engines had been tried hauling goods trains. They had begun with a load of 600 tons, and the larger engine had showed an economy in coal of 17 per cent. The loads had been gradually reduced, and the economy had also decreased until at 300 tons the coal consumption was equal. With regard to the question of cut-offs, in the cylinder to which Mr. Shawcross had referred, he could not quite see why the cut-off in the high-pressure cylinder should be so late. Probably Mr. Fry would be able to say something about that. Possibly it was due to the fact that there was always a great compression in high-pressure cylinders of compound engines. He had found that if one cut off earlier than about 35 per cent. of the stroke, compression began in the high pressure cylinder. Probably that was the reason why those

engines were run at such late cut-off. But where was the economy ?

With regard to the ratio of the cylinders, the French practice, as far as he could remember, was, two years ago, 2·143 to 1. He believed that the French people were building engines with a boiler pressure of 274 lb. per square inch, and the ratio was still kept at 2·143. Various ratios had been tried in France from time to time, from three down to two, and it had been found that about two was the best ratio. French engines at first had a very small receiver volume, but it had been found that by increasing the receiver volume the efficiency was increased, until the conclusion had been reached that the receiver volume should not be less than four times the displacement of the high-pressure cylinder. In Mr. Fry's paper the cut-off in the high pressure cylinder was given as considerably later than in the low-pressure cylinder. The French compounds cut off earlier in the high-pressure and later in the low-pressure. He quoted the following figures :—

20 per cent. high and 28 per cent. in the low.
40 per cent. high and 52 per cent. in the low.
60 per cent. high and 73 per cent. in the low.

He believed that if economy was sought an early cut-off was essential in the high-pressure cylinder.

Mr. Fry, in reply, said that the Chairman had asked whether reheating the steam between the cylinders had been tried. He did not know of any case in which that had been actually done. He knew that a design had been made, but it introduced very serious complications in taking the steam back into the superheater. Another speaker had asked why he had said that 500 lb. per square inch would be about the limit. He admitted that he might have to revise his estimate, but as 500 lb. to the square inch was exceeded, the possible increase in efficiency did not augment so quickly as it did up to that point, while the difficulties due to the higher pressure continued to increase rapidly. With reference to the question of superheating, there again it might be that he would have to revise his figures and go somewhat higher, but if, as Mr. Gass had pointed out, the steam was dry at exhaust, it was undesirable to go higher with the superheat, or else heat would be lost up the chimney. The reason for not going above the speed of 200 revolutions per minute in the tests was that, at that speed the capacity of the testing plant had been reached, an indicated horse-power of 4500 being obtained at that speed. Sir Henry had asked what type of steels were used in the tubes of the boiler. The answer was regular low carbon boiler steel for both the boiler and the tubes. He thoroughly agreed with Mr. Gresley as to the value of a locomotive testing plant. The Pennsylvania Railroad had used its testing plant to establish road ratings for its various types of locomotives. It had checked the results from the plant with the dynamometer car, and had found that it could safely rate its locomotives from the figures obtained on the plant. He had made a little study for the American Society of Mechanical Engineers about two years ago, and been able to show that the locomotive testing plant had had a great deal of influence on locomotive design. Mr. Gresley had asked why they had chosen a three-cylinder instead of a four-cylinder compound ? With a locomotive of that size it was impossible to make a good mechanical job of a crank axle with two throws between the frames. The space between the frames was definitely limited. The crank pin diameter was about 11in., and one could not build up a crank axle with two throws with pins of that diameter and have it stand up in service.

With reference to the intricate question of the cylinder ratios and valve gears, he agreed that it would have been interesting to have tested the locomotive with independent valve gears, so that various conditions might have been studied, but it had been decided to adopt the single valve control, and to employ ratios which promised satisfactory results. The test results on the plant and in service were such as to justify the arrangements adopted. Cylinder ratio was a question of compromise between mechanical advantages and cylinder efficiency.

Mr. Gresley had asked about the type of boiler, and had suggested a complete water-tube boiler. Mr. Fry said that it seemed to him that the fire tube type of barrel had a very great constructive advantage. The loss of boiler efficiency in a locomotive boiler was not mainly one of heat absorption. The figures for that engine showed that they absorbed from about 82 to 85 per cent. of the heat actually produced. When there were smoke-box temperatures ranging from 519 deg. to 640 deg. Fah. there was not much opportunity for an increase in efficiency of heat absorption.

Mr. Chambers had asked why he had chosen the locomotive cycle as a basis of reference for the comparison of the cylinder efficiencies. That point seemed to have caused quite a little attention and criticism. Both Mr. Diamond in London and Professor Lea in Leeds objected to the proposed modification of the Rankine cycle, and both did so, he thought, without fully understanding the reasons for proposing the so-called locomotive cycle. In the first place, he wished to point out that to propose a modification of the so-called Rankine cycle was not to lead an attack on a fundamental of thermodynamics. As a matter of fact, authorities differed in their definition of the Rankine cycle. Marks and Davis, in their widely used Steam Tables, said :—"In the Rankine cycle steam is admitted at a constant pressure, expands adiabatically to the back pressure, and is exhausted against a constant back pressure." Professor Lea, on the other hand, assumed adiabatic expansion down to the temperature of the feed-water. Now, if there was more than one Rankine cycle, it seemed permissible to adopt a definite modification of it, particularly if it could be shown to have certain practical advantages. In locomotive practice, the designer must restrict himself to a comparatively low ratio of expansion for reasons which were largely mechanical. To expand adiabatically all the way down to the feed-water temperature would require a condenser and enormous cylinders capable of giving over 400 expansions. Even to carry adiabatic expansion down to the back pressure of the exhaust would require over thirteen expansions, or cylinders over four times the volume of those actually used. At the same time, the steam would be abnormally wet.

Practical considerations, therefore, led the designer to adopt a ratio of expansion which was mechanically acceptable. The steam was expanded to that ratio, then released to, and exhausted at, the back pressure. The proposed locomotive cycle showed the maximum amount of work it was theoretically possible to take from the steam under the given conditions of admission, expansion and exhaust. Consequently, comparison of the actual indicator cards with the locomotive cycle was a reasonable measure of the designer's success in attaining the ideals he had set up. To compare the actual cards with the Rankine cycle, whether this was taken to the exhaust pressure or to the feed-water temperature, was to compare actual performance with an ideal standard which it was neither possible nor desirable to attain. The Rankine cycle based on the feed-water temperature was of interest, but for practical study with a view to determining possible improvements in cylinder design or operation, it was thought to be less useful than the proposed locomotive cycle.

Mr. Shawcross and other speakers had called attention to the long cut-off in the high-pressure cylinder. As was the case with the cylinder ratio, that was a matter of compromise. It should, however, be remembered that with a three-cylinder compound it was only desired to take out approximately one-third of the total work in the high-pressure cylinder. With a high initial pressure there was a rapid pressure drop with a comparatively small increase in volume, and consequently the required amount of work was taken out with a low degree of expansion.

In conclusion, Mr. Fry said he would like to say that "No. 60,000" was not necessarily the last word in locomotive design, but he did think that it was a step in the direction of the introduction of higher pressures and greater locomotive efficiency.

B.E.S.A. SPECIFICATIONS.

PLUG-IN COILS.

A NEW specification—the third British standard specification to be issued dealing with wireless material—which has just appeared, deals with the interchangeable type of plug-in coil, in which the two ends of the windings are connected to a pin and to a socket respectively, the following features being standardised :—(1) Dimensions of the plug portion and the tolerances thereon, in so far as interchangeability is concerned ; (2) a range of "sizes" based on the inductance values.

Owing to fluctuation in design, the Committee responsible for this specification has considered it inadvisable to standardise at the present time coils having intermediate tappings, but in view of the tendency towards the use of centre-tapped coils a recommendation is made in an appendix regarding the dimensions of the plug portion of such coils.

The standard range of coil sizes is very ingeniously designed so as to include coils suitable for all wave lengths from about 20 m. to 25,000 m., when in parallel, having a value of 0·001 microfarad or less. The range of coils is divided for convenience into five groups, designated by the letters S, B, M, L, and X, which signify that the coils in these groups are suitable for "short," "broadcasting," "medium," "long," and "extra-long" wave lengths respectively. There are five coils in each group, the induction values of these coils being so devised that the calibration chart—wave length against shunted capacity—for the five coils in any one group is identical in form with that for the coils in any other group, the inductance axes bearing a simple relation to each other. It is thus arranged that each coil in any group gives a wave length—with a given condenser setting—three times as great as that of the corresponding coil in the preceding group. The calibration chart given in the specification shows the simplicity and convenience of this arrangement very clearly. The schedule showing the wave lengths to which each coil can be tuned with various condenser settings also shows the corresponding kilocycle values.

Another useful feature dealt with by the specification is the standardisation of the method of connecting the ends of the winding to the plug.

It is understood that at a later date a further appendix will be added dealing with a performance test for coils, the degree of performance being indicated by a "figure of merit."

Apart from its usefulness to the manufacturers of coils, this specification should prove of great value to the constructors, amateur or otherwise, of wireless receiving sets, and also to all who use plug-in coils for experimental purposes.

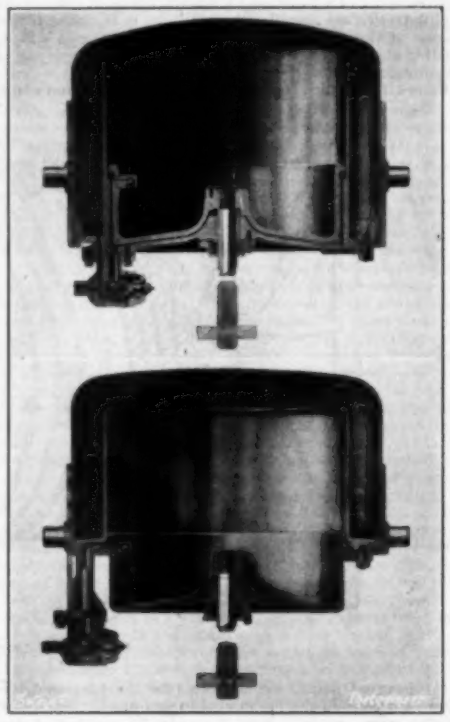
Copies of the specification—No. 289, 1927—may be obtained from the publications department, British Engineering Standards Association, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

Pressed Steel Vacuum Brake Cylinders.

BY making a few modifications in the design and processes of manufacture, the Westinghouse Brake and Saxby Signal Company, Ltd., of 82, York-road, King's Cross, London, N. 1, have effected a marked improvement in the cylinders used to operate vacuum brakes on railway rolling stock.

These improvements, which we studied at a demonstration at the maker's works on Monday, January 23rd, result in a reduction in the weight of the parts concerned and in a great saving in time and labour when the cylinder must be dismantled for a renewal of the rolling rubber ring which seals the joint between the piston and the cylinder.

As to the saving in weight, this is obvious from a comparison of Figs. 1 and 2, which represent the standard and new designs respectively. The actual saving is in the proportion of 268 lb. to 186 lb., and is effected by the employment of steel pressings in the place of iron castings. With reference to those parts which have to be handled when the rubber ring has to be renewed, the relative weights are 184 lb. and 66 lb. It will be readily appreciated that with the new pattern two men can easily



FIGS. 1 AND 2—VACUUM BRAKE CYLINDERS

handle the parts, whereas with the standard pattern a mate is necessary to lift them up into place in the confined space allowed for such operations.

The chief saving is, however, in the matter of time when the ring has to be changed, as with the new design it is unnecessary to remove the cylinder. In Fig. 1 the parts which must then be removed to expose the piston in the usual arrangement comprise the cylinder with its cover, the piston and the valve. But in the new design the cylinder is left and only the cover and piston are taken away. In this connection it should be pointed out that while in the engraving the cylinder and its container appear to be pressed out as one piece, they are actually two pressings connected together by a welded ring. It will also be noticed that the valve has been set back to clear the extended cylinder cover. Incidentally, several precautions against the leakage of air into the vacuum space have been adopted. For example, the retaining studs are screwed into blind holes and the piston-rod does not extend through the piston boss.

The adoption of these modifications has brought about an entire change in the process of renewing a piston ring. Instead of dismantling the whole cylinder, withdrawing the piston from the top and returning it, re-rubbered, downwards, which means forcing it down to the working position with the ring sliding, with the new arrangement the piston and cover only are taken off downward. Then a new ring is slipped in place and the assembly is bolted up again immediately in the working position. The saving in time thus effected needs no emphasis.

In discussing the relative merits of pressings and castings with the makers, we asked why it was not possible to make pressings of sufficient accuracy to make the joint with the rolling rubber ring without having to machine the surfaces. We learned that there is quite an art in machining these parts. They must be rough, more or less, to produce the rolling of the ring, and the roughness of the piston must correspond with that of the cylinder. So the roughness is produced in the form of corrugations, and the radius of the valley of these corrugations must correspond to the radius of the section of the rubber ring, or an air-tight joint will not be produced.

A Converted Drop Hammer Plant.

THE drop forging shop at the Chippenham, Wiltshire, works of the Westinghouse Brake and Saxby Signal Company, Ltd., contains three lines of drop-hammers, many of which have been running for more than twenty years. As originally set to work, the hammers were fitted with the type of steam lifter supplied at the time of their installation by their makers, Brett's Patent Lifter Company, Ltd., Foleshill Works, Coventry. The whole plant has now been converted to electrical driving, and each hammer has been fitted with Messrs. Brett's latest design of friction-driven lifter. The result obtained by the conversion has been a great saving in the running costs. The output, previously above the average, has, in addition, been more than maintained at its former level. We recently had an opportunity of inspecting the equipment, and are enabled to give some figures regarding its consumption of power which have been supplied to us by the consulting engineers in charge of the conversion, Messrs. Merz and McLellan.

The three rows of hammers contain altogether nineteen hammers divided into five batteries. Battery A consists of three 15-cwt. hammers and one at 7 cwt. Battery B has two 6 cwt. hammers and one each at 10 cwt., 12 cwt. and 15 cwt. In Battery C there are two 18-cwt. hammers and one at 7 cwt. Battery D has a 6-cwt., an 18-cwt. and a 20-cwt. hammer. Battery E consists of two 6-cwt. hammers and one each at 8 cwt. and 12 cwt. Each battery is driven by a separate 50 horse-power electric motor. Since the conversion was made provision has been arranged to add to the equipment two more batteries, one of which will consist of a 7-cwt. and a 40-cwt. hammer, and the other of a 7-cwt. and a 30-cwt. hammer. When the new batteries are completed the plant, it is claimed, will be one of the finest of its kind in existence, and will be capable of producing a very large variety of light and heavy drop forgings.

Before proceeding to consider the electrical details of the converted plant, we will describe the friction-driven lifters with which the hammers are equipped. The details of a lifter are shown in Figs. 1 and 3. The central shaft is driven at a constant speed in the clockwise direction as seen from the right-hand end. Fixed to and rotating with it are the grooved drum M and the winch drum E. Mounted freely on it are two lifting levers A A and a loose pulley L. A cross bar or shackle B is pivoted to the left-hand lifting lever A and is engaged between the jaws of the right-hand lever. The shackle carries a shoe H to which a series of friction blocks C is attached. The number of these blocks and of the grooves in the drum M with which they engage depends upon the size of the hammer. The blocks are provided with friction linings. A jaw J at the end of the shackle is linked to a lever D, which is pivoted to a bracket on the side of the right-hand lifting lever A. A spring F, the tension of which can be varied, connects one end of the lever D to the boss of the lifting lever A. At the other end the lever D is held by the control cord which, after passing once or twice round the winch drum E is taken down to a level convenient to the operator's hand.

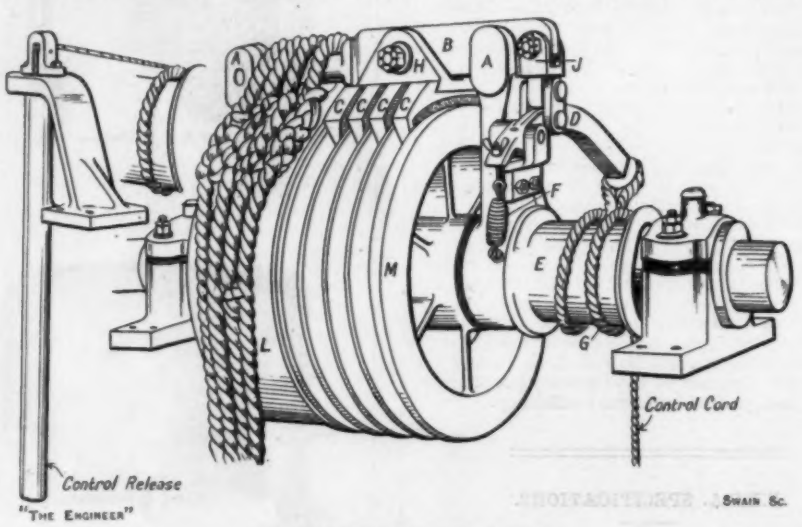


FIG. 1—FRICTION-DRIVEN LIFTER

If a pull is exerted on the control cord, the coils of that cord passing round the winch drum will tighten and the driving shaft will tend to pull the lever D after it. In so doing it will draw down the free end of the shackle B, and as a result the friction block C will engage with the grooves of the drum M. With this engagement established, the whole system, with the exception of the pulley L, becomes virtually connected to the driving shaft. The shackle B moving with the other parts pulls up the tup by means of the connecting ropes, which ropes wrap themselves round the loose pulley L. The size of the pulley L is such that about one-half of a revolution of the driving shaft is sufficient to raise the tup to its full height.

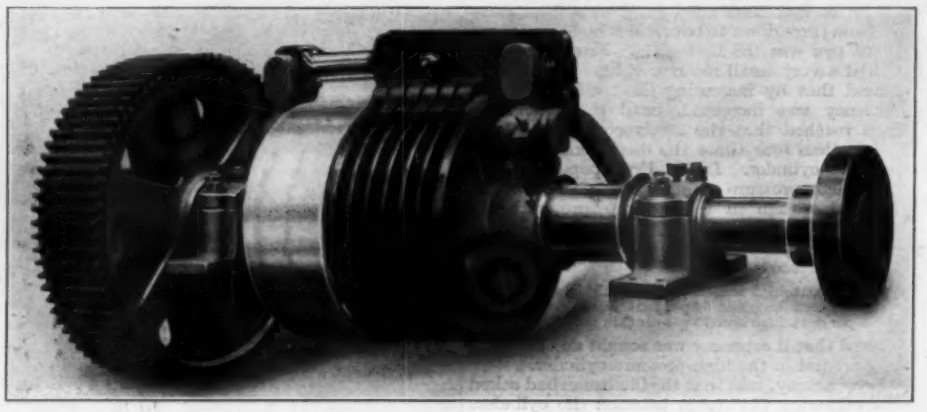


FIG. 3—FRICTION-DRIVEN LIFTER

When the pull exerted on the control cord is released, the spring F restores the shackle to its former position and disengages the friction blocks from the grooved pulley. The tup then falls. The action and efficiency of the mechanism depend largely upon the completeness with which the coils of the control cord release their hold on the winch drum when the pull on the cord is removed. If there is any stickiness in this release, the friction blocks will not completely disengage themselves from the grooved pulley, with the result that the force of the blow delivered by the falling tup will be reduced and power will be wasted in driving the shaft against the friction between the blocks and the grooves. To ensure the complete release of the control cord coils that cord is united as shown to the left of Fig. 1 by a light cord to a hanging weight arranged to exert a pull tending at all times to open the coils on the winch drum.

It is to be noted that the difference between the diameters of the drum E and the loose pulley L has the effect of making the movement of the handle at the end of the control cord much less than the movement of the tup which it causes. Again, the winch action of the drum E results in the application to the end of the lever D of a force considerably greater than the force exerted on the control cord by the operator. It follows therefore that the tup can be raised without the exertion of more than a small force through a small distance.

If a relatively light force is exerted on the control cord, the friction blocks will not be completely engaged with the grooves of the pulley M. Slipping will take place at these blocks—as also at the coils of the control rope round the winch drum—and if the pull on the control cord is correctly adjusted the frictional lifting force can be made just to balance the weight of the tup. In this way the tup can be held suspended in its guides at any desired height.

In the event of the operator maintaining the pull on the control cord longer than is required to raise the tup to the top of its stroke, the lifting arms A strike a pair of resiliently mounted wooden buffers. The contact of the arms and buffers will cause the operator to release the pull before any damage can be done.

In Fig. 2 we illustrate the general driving arrangement of two of the Chippenham batteries. For the whole plant five motors are employed. In order to secure interchangeability, the motors are all of the same type and size. They are of the squirrel-cage induction type, running at 575 r.p.m., and have a half-hour rating of 80 horse-power each. The total weight of the nineteen hammers is 220 cwt.,

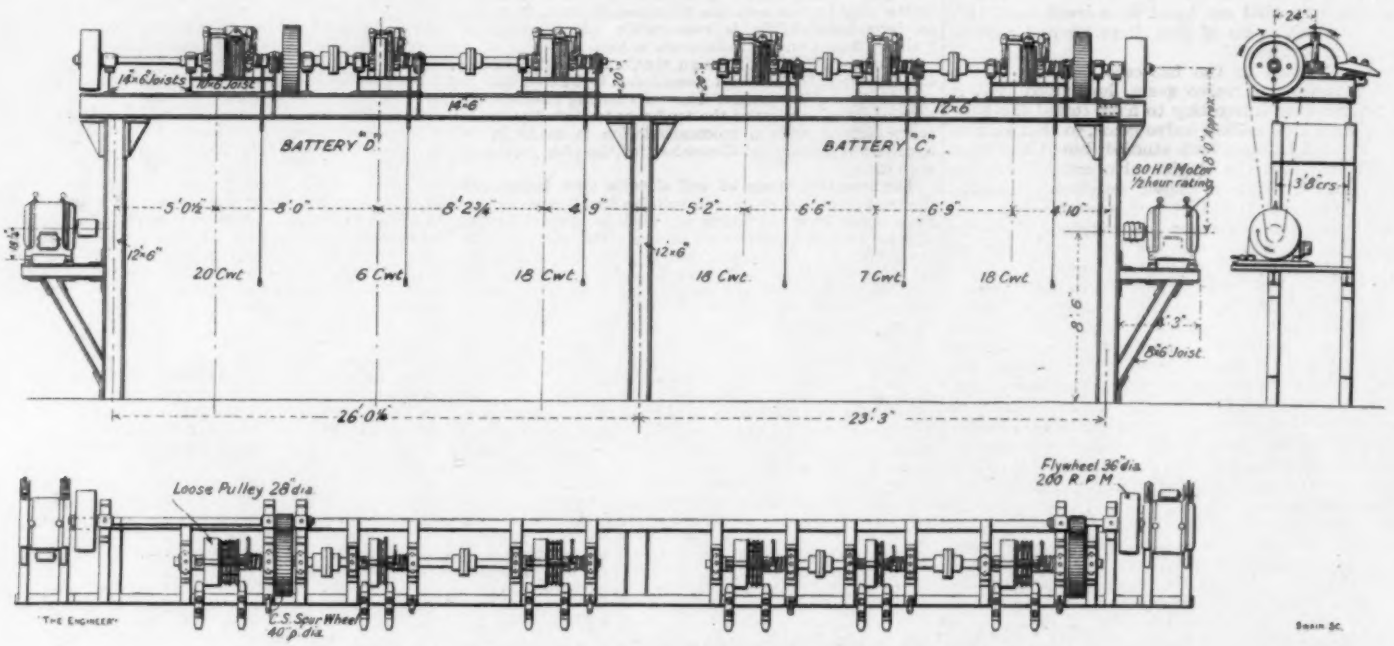


FIG. 2—DRIVING ARRANGEMENT OF TWO BATTERIES OF DROP HAMMERS AT CHIPPENHAM

and as far as possible the batteries have been arranged with uniformity in the total weight of the hammers included in each. In order to economise floor space, the driving motors are mounted on rolled steel brackets

FIG. 4—PART OF THE CHIPPENHAM PLANT

attached to the main end standards of the battery frames. From the motors power is transmitted by belt to overhead fly-wheels, running at 200 r.p.m. The fly-wheels are mounted on back shafts which are connected through single reduction spur gearing to the driving shafts of the friction lifters. The reduction ratio of the gearing is 5 to 1, so that the lifter shafts run at 40 r.p.m. In Fig. 4 we give an illustration showing a portion of the Chippenham plant and in Fig. 5 a view of part of the driving details of a battery.

The conversion of the equipment from steam to electric

FIG. 5—DRIVING DETAILS OF ONE BATTERY

driving had to be carried out with the least possible degree of interruption to the normal working of the department. The batteries were converted one at a time, mainly during week-ends. The first battery was running under electric power in January, 1927, and the whole of the conversion was completed by the end of March.

The total power of the motors installed is 400 horse-power on a half-hour rating. The rating of the motors does not, however, bear any close relationship to the mean electrical load involved, because of the very high instantaneous loads encountered, and the great diversity of these peak loads. With all the nineteen hammers at work under normal conditions, the highest instantaneous peak loads observed are of the order of 200 horse-power. The nature of the load is, however, highly intermittent, and the mean demand over any considerable period is much reduced. Over the full working day it is not more than 40 kilowatts, with periods of half an hour or so during which it rises to 45 kilowatts. At a tariff rate of 1d. per unit, the total power cost for all the hammers having a total weight of 220 cwt. is about 25s. per working day of eight hours. This figure is, however, dependent upon the class of stampings being produced, and upon other factors. The amount of power expended on the actual lifting of the hammers is noticeably small. When all the batteries are running light, the sustained demand for power is just a little under 30 kilowatts.

Lloyd's Register: Annual Summary.

LLOYD'S Register Annual Summary of the Mercantile Shipbuilding of the World for the year 1927, has just been published, and, following our usual custom, we give below a *précis* of its contents. It will be remembered that this summary does not include warships, and that it takes into account only merchant vessels of 100 tons gross and upwards, that were launched in 1927, whether they were completed during the year or are still under construction. Sailing vessels fitted with auxiliary power are included with steamers or motor ships, according to type of engine. Returns are not available as regards Germany and Austria-Hungary for the war period (1914–18), nor as regards Germany for 1919 and 1920.

GREAT BRITAIN AND IRELAND.

Particulars of Total Output.—During the year 1927 there were launched in Great Britain and Ireland 371 merchant vessels of 1,225,873 tons, viz., 276 steamers of 865,472 tons, 80 motor ships of 355,779 tons, and 15 barges of 4622 tons. With the exception of a composite yacht fitted with auxiliary engines, all these vessels are built of steel, and not a single sailing vessel was launched during the year. The output for 1927 was 586,305 tons higher than that for the year 1926. The present total represents 53·6 per cent. of the world's output for 1927, as compared with 38·2 per cent. in 1926, 49·5 per cent. in 1925, 64·1 per cent. in 1924, 39·2 per cent. in 1923, and 58 per cent. in 1913.

Nationality of Vessels Launched.—Of the tonnage launched during the year, 958,154 tons are for registration in Great Britain and Ireland, and 267,719 tons—21·8 per cent. of the total tonnage—are for owners residing abroad. This percentage compares with 14 per cent. in 1926, under 16½ per cent. in 1925, under 15¼ per cent. in 1924, less than 3 per cent. in 1923, and an average of over 22 per cent. for the five pre-war years, 1909–1913. No less than 113,254 tons are intended for registration in the British Dominions overseas.

Size and Type of Vessels.—The returns for 1927 show that 86 vessels of between 5000 tons and 10,000 tons each and 7 vessels of 10,000 tons and upwards were launched. The largest are the turbine steamers "Duchess of Atholl" (21,500 tons), and "Orford" (20,000 tons); the "Laurentic" (18,724 tons) fitted with a combination of turbines and reciprocating engines, and the motor ship "Bermuda" (16,000 tons). Excluding vessels of less than 1000 tons, 62 vessels of 305,781 tons, for the carriage of oil in bulk were launched during 1927. Of them, 45 vessels of about 258,000 tons, and two other vessels of 7830 tons, were built on the Isherwood system of longitudinal framing. The tonnage of steamers fitted for burning oil fuel, launched during the year, amounted to nearly 300,000 tons. The tanker tonnage represented nearly 25 per cent. of the total tonnage launched during the year. The returns include a number of vessels designed for channel, coasting, fishing, towing, harbour service, and other special purposes. The average tonnage of steamers and motor ships launched during the year was 3430 tons. If the vessels of less than 500 tons are excluded, the average is increased to 4193 tons, as compared with 4486 in 1926, 4439 in 1925, 3777 in 1924, 3805 in 1923, and 5186 in 1922.

Vessels Fitted with Turbines.—Further progress was recorded in the use of steam turbines during 1927, when 13 vessels with a total tonnage of 137,628 tons were launched which will be fitted with this method of propulsion. These figures include a vessel of 18,724 tons, which has a combination of steam turbines and reciprocating engines. It will be seen that the average tonnage of these vessels reached the high figure of 10,587 tons.

Vessels Fitted with Internal-combustion Engines.—The tonnage of vessels fitted with internal-combustion engines is steadily increasing in comparison with the total output. The tonnage of such vessels launched during 1919 was 32,936 tons, while during 1925 it amounted to 267,217 tons, and to 201,913 tons during 1926. During the year 1927, 80 motor ships of 355,779 tons were launched, that tonnage equalling 41·1 per cent. of the *steam tonnage* launched. The largest motor ship launched during the year was the "Bermuda," of about 16,000 tons, and it may be stated that of the 52 vessels of 6000 tons and upwards, launched during the year, 29 are to be fitted with oil engines.

Output of Leading Ports.—The Clyde district occupies first place amongst the shipbuilding centres, showing an output of 423,723 tons. Then follow the Tyne—274,056 tons—the Wear—162,770 tons—the Tees—130,371 tons—Belfast—107,181 tons—and the Mersey—36,636 tons. The largest increase, as compared with 1926, took place on the Clyde, the figures for which were 156,078 tons higher than in the previous year. The increase on the Tyne amounted to 147,447 tons, on the Wear to 127,583 tons, and on the Tees to 93,188 tons.

Progress of Shipbuilding During the Year.—As regards the movement of the shipbuilding industry during the course of 1927, Lloyd's Register Quarterly Returns show that at the opening of the year 760,084 tons were under construction in Great Britain and Ireland. The returns issued during 1927 showed a steady increase throughout the year, and on December 31st, 1927, the tonnage under construction in Great Britain and Ireland amounted to 1,579,713 tons, or 819,629 tons more than twelve months earlier. The figures for the end of 1927 were the highest recorded since September, 1922, but still showed a reduction of 310,000 tons as compared with the average tonnage building during the twelve months immediately preceding the war. It should also be stated that at the end of 1927 the totals only included 5550 tons on which work was suspended, while at the end of 1926 such tonnage was nearly 100,000 tons.

OTHER COUNTRIES.

Particulars of Total Output.—There were launched abroad during the year 431 merchant vessels of 1,059,806 tons—204 steamers of 510,356 tons, 174 motor vessels of 507,915 tons, and 53 sailing vessels and barges of 41,535 tons. The figures show an increase of 24,397 tons as compared with those for 1926, and a decrease of 4,464,301 tons as compared with 1919—the record year—and they are 340,923 tons lower than those for 1913, during which year the highest pre-war total was reached.

Size and Type of Vessels.—The returns for the year include 33 vessels of between 4000 tons and 6000 tons each; 34 of between 6000 tons and 8000 tons; 16 of between 8000 tons and 10,000 tons; and 12 of over 10,000 tons each, the largest being the turbine steamer "Cap Arcona," of 27,561 tons, launched at Hamburg. There were launched during the year 25 vessels of a total tonnage of 198,635 tons to be fitted with turbines. This total includes two vessels of 30,806 tons, in which the turbines are used in conjunction with electric motors, and nine vessels of 36,215 tons which have a combination of steam turbines and reciprocating engines. Of the 25 vessels, four are of more than 10,000 tons each, the largest being the "Cap Arcona," of 27,561 tons. Excluding vessels of less than 1000 tons, the output abroad for the year also comprises 19 vessels, of about 138,000 tons, built on the Isherwood system of longitudinal framing. Including 17 of these vessels of about 129,000 tons, there were launched during the year 37 vessels of about 237,000 tons for the carriage of oil in bulk. Of these tankers, 31 about 212,000 tons are fitted with oil engines. During 1927 there were launched 174 vessels of 507,915 tons to be fitted with internal-combustion engines, as compared with 169 of 502,093 tons in 1926. Fifty-nine of those launched during the year are of over 4000 tons each, including seven of 10,000 tons and upwards. Of those exceeding 4000 tons, 13 were launched in Germany, 10 in Sweden, 9 in Holland and 8 in Denmark; the two largest being the "C. O. Stillman" of about 16,000 tons, built in Germany, and the "Christiaan Huygens," of 15,636 tons, built in Holland. The total figures for motor ships include a few sailing vessels fitted with auxiliary power. Of the steam tonnage launched abroad during the year about 170,000 tons are fitted for burning oil fuel. The tonnage of wood vessels included in the year's total is only 17,273 tons, as compared with 14,753 tons in 1926, and 1,145,582 tons in the war year 1918, when the tonnage of wood vessels launched amounted to 28 per cent. of the total output. With the exception of a training ship of 1257 tons, built in Germany, and a schooner of 102 tons, built in Newfoundland, the totals for sailing vessels and barges—53 of 41,535 tons—are composed of craft which cannot be described as real sailing tonnage. The countries in which the largest output took place during the year under review were Germany, United States, Holland, Italy, Denmark and Sweden. The totals for those countries amounted to 829,105 tons, and account for 78¼ per cent. of the total output abroad.

Germany.—During the year under review 105 vessels of 289,622 tons were launched. As compared with the output for 1926, the present figures show the large increase of 109,074 tons and represent 27½ per cent. of the total output abroad during 1927, as compared with only 17½ per cent. in 1926. These figures include 12 vessels of 78,676 tons to be fitted with steam turbines, including the largest vessel launched in the world during 1927, viz., the "Cap Arcona," of 27,561 tons; the totals for turbine vessels comprise eight vessels of 35,115 tons, which will have a combination of steam turbines and reciprocating engines. The total figures comprise, also, 33 vessels of 115,882 tons to be fitted with oil engines, the largest being the motor tanker "C. O. Stillman," of about 16,000 tons. Four tankers, of 35,097 tons—all motor ships—were launched. The totals include 14 vessels of between 6000 tons and 8000 tons, 4 of between 8000 tons and 10,000 tons and 3 vessels of above 10,000 tons each.

United States.—The output for the year 1927, namely, 179,218 tons, was 28,605 tons higher than during 1926. Of the tonnage launched, 17 steamers and motor ships of 82,754 tons and 30 barges of 24,800 tons were built on the Atlantic Coast, eight steamers of 54,948 tons on the Great Lakes, and 11 vessels of 16,716 tons on the Pacific Coast. The largest vessels launched during the year were the turbo-electric vessel "California," of about 22,000 tons, built at Newport News, and the motor ship "Gulfpride," of 12,510 tons, built at Kearny, N.J.; four other vessels of between 6000 tons and 10,000 tons were launched on the Atlantic Coast; and one of 10,180 tons, and four between 8000 tons and 10,000 tons were launched on the Great Lakes. Six turbine steamers of 54,916 tons were launched in this country during 1927, including two vessels, the above-mentioned "California," and one other vessel of 8816 tons, both fitted with turbines in conjunction with electric motors. The motor tonnage launched amounted to 39,282 tons. Of oil tankers of 1000 tons and upwards,

five of 37,318 tons were launched. The totals also include five vessels of 39,261 tons built on the Isherwood system of longitudinal framing.

Holland.—The total tonnage launched during 1927—119,790 tons—was 26,119 tons higher than the 1926 figures. As usual, the figures for this country do not include vessels exclusively intended for river navigation, the total tonnage of which vessels reaches a high figure. Seven vessels of over 6000 tons each were launched. The totals for the year include 49 vessels of 86,194 tons to be fitted with internal-combustion engines. Eight motor ships are of 6000 tons and upwards, the largest being the "Christiaan Huygens" of 15,636 tons and the "Sibajak" of 12,040 tons. Four motor ships of 25,227 tons are intended for the carriage of oil in bulk.

Italy.—The total figures for Italy—101,076 tons—were 118,945 tons lower than those for 1926, which were the highest ever reached in that country. Eighteen vessels of 73,955 tons were launched in the Trieste district, as compared with an output of 94,136 tons during the previous year. The totals comprise three vessels of 10,000 tons and upwards, the largest being the turbine steamers "Conte Grande," of about 22,800 tons, launched at Trieste, and "Ausonia," of 13,500 tons, launched at Genoa. Thirteen motor ships of 49,698 tons were launched, the largest being the "Virgilio," of 11,920 tons, built at Baia, near Naples.

Denmark.—The total tonnage launched during 1927—72,038 tons—was practically the same as last year, and was composed mostly of motor ship tonnage—63,690 tons. Seven motor ships of between 5000 tons and 9150 tons were launched, six of which, with a total tonnage of 44,501 tons, are intended for the carriage of oil in bulk.

Sweden.—The output for 1927—67,361 tons—was 13,843 tons more than that for 1926, and is the highest ever recorded in this country. Over 92¼ per cent. of the total is composed of motor ships, of which eight are of between 5000 tons and 7000 tons each. The tankers launched—all motor ships—amount to seven, of 42,566 tons.

France.—The output for the year—44,335 tons—is 77,027 tons lower than that for 1926, and is the lowest recorded since 1919. The total figures include one steamer of 9950 tons, five motor ships of 17,076 tons, and six trawlers of over 1000 tons each.

Russia.—The shipbuilding activity in this country, which has been developing for the last two years, resulted in the launching, during 1927, of 18 vessels, of 43,917 tons. These figures include 10 motor ships, of 25,414 tons, one of which—an oil tanker—is of about 7000 tons, and two are of 4957 tons each.

Japan.—The output for this country—42,359 tons—is 10,046 tons less than that in 1926, and is the lowest recorded since 1910. The 1927 totals comprise two motor ships, of 5612 tons each, and two turbine steamers, of about 4280 tons each.

British Dominions.—The total tonnage launched in all the British Dominions Overseas during 1927, namely, 30,250 tons, is slightly less than in 1926. Of the total output, 23,773 tons were launched in Canada, including 10,131 tons on the Great Lakes. The totals include two steamers, of between 6000 tons and 7000 tons each, launched at Levis, Quebec.

Progress of Shipbuilding Abroad During the Year.

Dealing with the combined totals for the work in hand in the various countries abroad, a large increase has taken place during 1927. At the beginning of the year the tonnage under construction amounted to 1,172,943 tons, and at the end of December the total was 1,539,008 tons, an increase of 366,065 tons. This increase, however, has not been general; while in some countries there has been a considerable addition to the work in hand, in other countries a large decrease has taken place. The countries which showed the largest increases are:—Germany, 261,233 tons; Sweden, 61,573 tons; Denmark, 56,568 tons; Russia, 33,238 tons; and Holland, 29,882 tons; while considerable decreases have taken place in Italy, 56,560 tons; United States, 54,265 tons; and France, 28,039 tons. The returns for the fourth quarter show that at the end of 1927, the countries abroad having the largest amount of tonnage under construction are:—Germany, 472,295 tons; Italy, 183,216 tons; Holland, 174,887 tons; France, 115,029 tons; and Sweden, 100,700 tons. The tonnage commenced during the fourth quarter shows a considerable decrease compared with the average figure for the previous four quarters and would appear to indicate that, in general, the amount of work in hand in the shipbuilding yards abroad is not likely to show an increase within the near future.

Summary of World's Output.

The total output during 1927 reached 2,285,679 tons. These figures represent the large increase of 610,702 tons as compared with 1926. As compared with 1913, during which year the pre-war world's record output was reached, the present figures still show a decrease of over 1,000,000 tons. The output in Great Britain and Ireland represented 53·6 per cent. of the world's output during 1927, an increase of 15·4 per cent. compared with the similar figure for 1926.

Some interesting facts may be gathered from this summary as regard the special types of vessels and machinery included in the output of the year under review. The total launches comprised 38 vessels of over 336,000 tons to be fitted with steam turbines, including some vessels having a combination of steam turbines and reciprocating engines. During 1927, 863,694 tons were launched in which internal-combustion engines are being fitted. This tonnage compares with 704,006 tons launched in 1926. The present total is equal to about 62·8 per cent. of the world's output of *steam tonnage*, as compared with about 76 per cent. in 1926. It should be stated, however, that the tonnage of motor ships being built in the world at the beginning of 1928 was actually 115,000 tons larger than the *steam tonnage* under construction. Of the total steam tonnage—1,375,828 tons—launched in the world, some 470,000 tons refer to steamers fitted for burning oil fuel under the boilers, so that the tonnage depending exclusively upon coal for propulsion only amounts to 39·6 per cent. of the world total for 1927. The tankers launched during 1927 amounted to 99 vessels of 542,437 tons, as compared with 246,000 tons in 1926.

It will be of interest to compare the total of the world merchant fleets in 1914 with the latest available figures. Disregarding sailing vessels and wood steamers, in view of their comparatively small importance in international trade, the gross tonnage of *seagoing* steel and iron steamers and motor ships amounted in June, 1914, to 42,514,000 tons, while at June, 1927, the figures reached 59,688,000 tons—an increase of over 17 million tons.

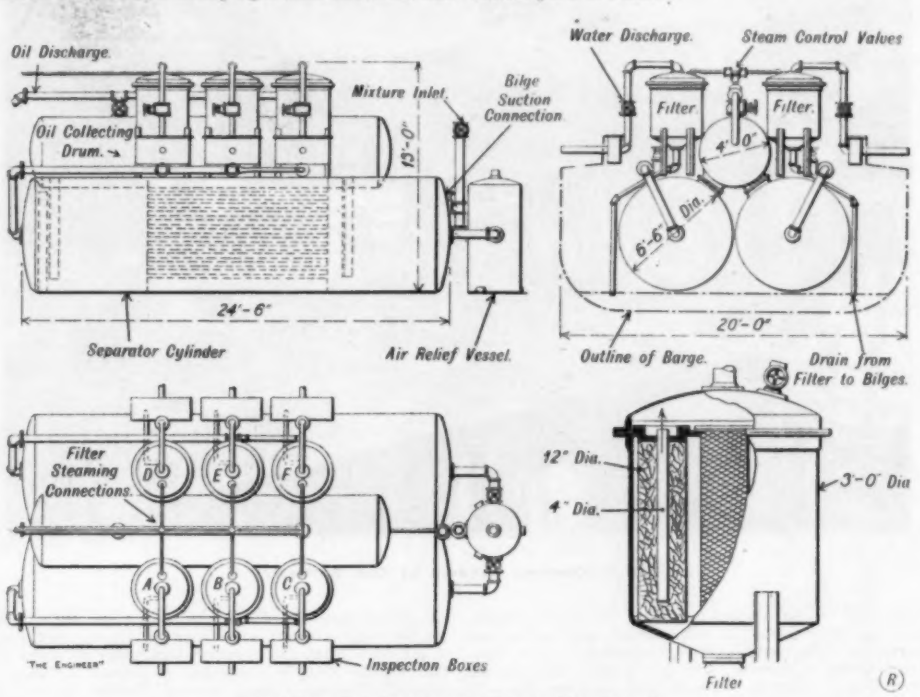
A remarkable change has taken place in the total tonnage of some types of vessels included in the above figures. For instance, the tankers which in 1914 totalled 1,479,000 tons now amount to 5,916,000 tons; and motor ships which in 1914 only reached 234,000 tons now amount to 4,271,000 tons—including auxiliaries. A great change has also taken place in the relative use of coal and oil fuel for boilers. In 1914 the tonnage of the steamers fitted for oil fuel was 1,310,000 tons, whilst in 1927 figures show nearly 18¼ million tons.

200-Ton Oil Separator for the Japanese Navy.

Interest in the problem of preventing the pollution of harbours and seas by the discharge of oily refuse into the sea at points within 50 miles of any coast has been revived by the recent Fleet Order of the Admiralty prohibiting such discharge, and also forbidding the handing over of oily refuse to sullage contractors. By an international regulation, oily refuse must not be discharged into the sea within 50 miles of the nearest coast. To attain such a distance not infrequently entails a voyage of considerable length on the western and southern coasts of this country, for example, the discharging vessels have to make outwards voyage of between 100 even up to 270 miles.

It is therefore cheaper to deal with the oily effluent in separators installed aboard ship or by a special oil separator barge attached to a port. Last year the Stream-Line Filter Company, Ltd., of 45, Horseferry-road, Westminster, S.W. 1, built for the British Navy a separator equipment which was placed on the lighter "C 73," and is now in service at Devonport. On Wednesday of last week, January 18th, we had the pleasure of inspecting under test a 200-ton plant of similar design, which has been built at the works of the Steel Barrel Company, Ltd., Uxbridge, to the order of the Stream-Line Filter Company, and after undergoing successful trials has been accepted by the Imperial Japanese Navy and shipped to Japan for re-erection in a barge.

We show in the accompanying illustration a general outline of the separator plant and a section through one of the six filters. From the top right-hand view, some idea of the lay-out in the barge may be gathered. Attention may be drawn to the raised filters which give a convenient arrangement of water discharge. The oily mixture enters a stand pipe at the right-hand end of the two separator cylinders, which is also furnished with a bilge suction connection. It is first delivered to an air freeing vessel, and then passes direct to the two separator cylinders. These take the form of riveted vessels, 6ft. 6in. in diameter, with a length of about 24ft. 6in., and within them—as shown by the dotted lines—there is an arrangement of baffles and a nest of 1¼in. diameter steel tubes, about 6ft. long. On entering the cylinder the first baffle plate causes the mixture to take a downward course, which incidentally separates off any bulk oil. The finer globules are then progressively released as the oily water passes in stream-line flow through the nest of piled tubes, each of which is provided with perforations on its upper surface, so that the oil globules can escape to a raised oil-collecting drum, placed between the two separator cylinders. After flowing over a further baffle, the water, which is by this time largely free from oil, passes to six filters, which remove the last traces of oil contamination.



200-Ton Oil Separator Barge Equipment

A section through one of these filters is reproduced to the right of our engraving. It consists of a riveted steel vessel with a removable cover, giving access to seven filter baskets. The baskets are about 12in. in diameter, with a length of 3ft., and they have a central aperture of about 4in. in diameter. The annular space between the walls of fine wire gauze is packed with "glass silk," having a fibre thickness of about $^1/_{100}$in., which exposes a very large surface to the liquid to be filtered. It has been calculated that 1 lb. of this material presents a surface of close upon 9000 square feet. The water containing minute traces of oil enters the baskets from the outside, and flows through to the inside. Any oil remaining is deposited on the fibres of the filtering material and can be removed by steaming in the reverse direction of flow. For this purpose steam pipe connections are fitted, as are also drains to the bilges. After the water leaves the filter, it passes through a rectangular inspection box, which may either be used as an open discharge for oil film inspection, or it may be packed with glass silk, which shows by its discoloration whether any traces of oil still remain on the filtrate. After the very exhaustive tests we are about to describe, one of the boxes so filled was found to be entirely clean, thereby demonstrating the effective working of the filters. The filtrate we examined was quite clean, without any trace of oil film. The oil which is separated out accumulates in the collecting drum by the displacement of water, and as the plant is worked under a closed system with a pressure of 3 lb. to 4 lb. per square inch, it can be discharged in any position required.

Summary of Tests.—As it was not possible to test the plant, we have described, in the barge at sea, special provisions had to be made to meet the requirements of the specification. The rated capacity of the plant is 200 tons per hour, and it was required to test each separator cylinder for a five-hour period for each cylinder in them, using mixtures containing 5, 10 and 15 per cent. oil. These conditions were met by providing a large mixture supply tank, and circulating through the system a mixture of oil and water at a rate sufficient to test each of the six filters separately. The proportion of oil in the mixture circulated was varied by adjusting the level of the liquid in the supply tank, so that the pump sucked either more or less oil, as was required. The oil contents of the various mixtures are given in the following tables. In normal service, four filters will be employed and a rate of flow was chosen which gave a 20 per cent. overload for each filter tested, which was made to pass 60 tons, instead of 50 tons per hour. Two of the filters will in ordinary service be held in reserve, which will give the plant a large overload capacity. Although steam cleaning was not required during the actual test, it was demonstrated afterwards. Cleaning generally takes, we are informed, from 15 to 20 minutes to complete.

The guarantee for the purity of the effluent was the same as that given to the British Admiralty, namely, that it should not contain more than one part of oil in 200,000 parts of water.

As the following figures show, this guarantee was considerably improved upon in the actual tests:—

Summary of Tests.

First Day Tests, Tuesday Afternoon, January 17th.

Time.	Filter under test.	Oil content of mixture supplied.	Oil content of effluent water, parts per million
12.30–1.30	A	1%	Less than 0·1
1.30– 3.50	B	1%, increasing up to 6%	Less than 0·1
3.50– 5.0	C	6%, increasing up to 82%	0·9
5.0 – 5.30	A	20%	0·7

Second Day Tests, Wednesday Morning, January 18th.

11.15–12.55	D	1%, increasing up to 5%	0·3
12.55– 2.35	E	5%, increasing up to 74%	1·1
2.35– 4.15	F	74%, decreasing to 11%	0·8

The plant we have described is larger and is provided

with more filters than would be used for an equipment designed for ship use, such as the 150-ton plant fitted by the Stream-Line Filter Company, Ltd., on the "Mauretania," or the 50-ton plant which is to be installed by the same firm on one of the two Grace motor passenger and cargo liners "Santa Barbara" and "Santa Maria," which are now approaching completion at the yards of the Furness Shipbuilding Company, Ltd., Haverton Hill-on-Tees.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Caution Predominant.

In the iron and steel industries of the Midlands and Staffordshire business continues quiet, and the attendance at the weekly meeting of the trade was small. Hopes of an early expansion of buying are still held, though it must be admitted that up to the present consumers have displayed little desire to purchase outside the limits of early requirements, which, according to statements of manufacturers on 'Change in Birmingham to-day—Thursday—are not large. Very small tonnages they say will carry them on during this quarter unless some new and really substantial orders are booked in the meantime. Some of them, better placed than their fellows, have arranged for their quarter's supplies of material, but they are few. A policy of caution, brought about by past experiences and present doubts, has been almost generally adopted, and any trade revival will have to come along in no wavering manner if it is to convince Midland industrialists of its reality. For some weeks now, good inquiries have been in circulation, but they are so long in materialising that producers doubt the genuineness of many of them. They declare that values are now at their very lowest, and that big business could hardly be accepted at lower figures. In the raw iron department some furnacemen have even gone so far as to issue circulars pointing out that present prices are so much below cost that they cannot continue. Northamptonshire blast-furnacemen have by agreement refused to accept recent rates as being below the profit-showing line. However, users of iron and steel show no inclination to secure stocks at present prices. They are evidently unconvinced that bottom has been reached. Producers and consumers alike hesitate to commit themselves. Times have been and are so bad, that they feel indisposed to take any chances. Merchants are almost in the same position. They do not carry the stocks they used to do a year or so ago. Micawber-like Midland industrialists are "waiting for something to turn up," but they are adding a prayer that it will hasten along.

Staffordshire Bars.

Staffordshire marked bar firms have the best orders in the finished iron department, and engineering requirements are such as to encourage the hope of better business in the immediate future. Prices are steady at £12 10s. Crown bars continue to be quoted from £9 2s. 6d. to £10 10s., but there is no great bulk of trade passing in this line. There is even less being done in Staffordshire nut and bolt and fencing bars at £9. Belgian No. 3 iron, which continues to be used in the Black Country works has stiffened in price, but the difference is still so great as to leave local makers no chance in competition. In the strip branch of manufacture local ironworks are doing better. Tube works are fairly busy and are utilising a larger proportion of wrought iron strip in their manufactures. This is the most encouraging side of the Staffordshire iron trade at the moment.

Raw Iron.

A mist still overhangs the Midland pig iron industry. Consumers, who cannot see clearly ahead of them, are content to buy in small lots of 50 to 100 tons for prompt delivery. The unstable price situation has put an end to what chances there were of booking forward contracts. Whereas a few weeks ago Derbyshire makers were adamant as regards their quotations, and Northamptonshire smelters were prepared to shade the recognised terms, the position has now been reversed. Derbyshire houses this week were, in many cases, prepared to accept £3 4s. for No. 3 foundry, or 1s. per ton below other makers' figures. Northampton blast-furnacemen maintain the attitude they adopted at the quarterly meeting, and refuse to do business at below £3. Orders accepted at less they maintain only increase their losses. Until the position has settled itself little increase in activity is likely. The better demand for forge qualities reported in some quarters does not appear to have been experienced in the Midlands. Very little forge iron is being sold here, and prices are nominal. A medium amount of hematite is being taken from the Scotch furnaces, prices having reacted further, and some high-class iron from the North-East coast has also been brought to this district. Foreign iron appears to have completely disappeared from the Midland foundries, present prices not offering sufficient inducement to local founders to buy abroad.

Steel.

Boiler plates and strip are the most active departments of the steel industry in this area, steel demand generally being but poor. Railway orders develop slowly, structural engineers' orders involve only small tonnages, demand for shipbuilding steel is only moderate, and general engineers' requirements are unsatisfactory. Mills are badly in need of orders for structural plates and sections. Fortunately there is a better call for boiler-plates owing to the large amount of plant renovation and renewal. They are easily maintained at £11. A little more has been paid in some instances. Steel strip is also a good market. Imported steel strip for tube-making has hardened to £6 15s., as compared with £7 15s. for strip rolled here from foreign bars, and at this figure it does not commend itself to local consumers, who want quicker delivery than continental makers can guarantee. Small steel bars re-rolled from continental material are selling at from £7 7s. 6d. upwards, though rollers assert that £7 10s. is the profit minimum. Competition is keen, however, and some mills are prepared to do business at the lower figure. Soft billets are offered at £6 upwards, while Staffordshire hoops are £10 10s. at works. The higher level of foreign quotations is maintained, and the volume of business passing in these materials appears to have fallen off somewhat, though it is still considerable.

Galvanised Sheets.

This week there have been improved inquiries, and orders for galvanised sheets, and mills are a little better employed. Business has been done with India and South and Central Africa, and further orders in the near future are expected. Home demand does not show much expansion. Values of 24-gauge corrugateds continue on the basis of £13 per export and £13 2s. 6d. for home consumption. Black sheets sell fairly well and the improvement recently noted in the tin-plate trade is maintained.

Scrap.

Demand for scrap is again being experienced, but buyers press for lower terms. Reports credit some sellers with having accepted a reduction of 2s. 6d. per ton, but heavy sales have been made at £3 delivered South Wales, and most suppliers require this figure.

Fuel.

Coke suppliers have been endeavouring to stabilise blast-furnace coke on the basis of 13s. per ton at ovens, but so far without much success. Midland smelters can buy on the open market adequate supplies to meet their present needs at 12s. 6d. per ton. Even with coke at this price pig iron smelters are unable to dispose of all their production at a profit. Naturally they are disinclined to pay more for coke.

Midland Coal Marketing Scheme.

It is understood that the co-operative coal marketing scheme for the Yorkshire, Derbyshire and Notts. coalfields is likely to be definitely adopted in the near future. It is announced that the scheme is being constituted, and the formation of three main committees is proceeding. It is pretty generally agreed in the trade that some sort of control over output is necessary to restabilise the market. Obviously the industry cannot go on trading at a loss, as it has been doing for the greater part of the time since the disastrous dispute. United effort is necessary if the scheme is to be a success, and other Midland districts have been invited to join the three counties named. There is a prospect that eventually the whole of the Midland coalfield, including Lancashire, will be included in the scheme. Collieries whose sales are confined to the home market are waiting an assurance that they will get the benefit promised to them in the abatement of ruinous competition from exporting collieries in the inland market before coming to a decision. Cannock Chase coalowners do not appear generally in favour of the scheme. They fear the movement may be used to smother development, and so deny to efficiently equipped collieries, such as many of those on the Chase, the fair reward of enterprise. At the moment there seems to be little prospect of Cannock Chase participating in the scheme, at any rate for the present.

Unemployment.

As anticipated the latest unemployment statistics for the Midlands area show a further substantial decline, the total recorded of 144,548 being 6194 lower than for the preceding week. Of the total 103,364 are men, 31,872 women, 4462 boys, and 4850 girls. In the Birmingham area there has been a further decrease of 1539, bringing the total to 27,649, and in the Stoke-on-Trent area a decrease of 2228, making the figure 18,265. Slight increases were reported at Nottingham and Walsall.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Retrospect and Prospects.

Without being too optimistic, a fairly hopeful view is taken of the industrial situation by the Executive Committee of the Engineering and Metals Section of the Manchester Chamber of Commerce in its annual report covering the past twelve months. Compared with the past few years, it is pointed out, the year 1927 was one of slightly better progress in respect of the volume of business placed, though the general level of prices obtained left much to be desired. The heavy iron and steel industries remain depressed, but that section which deals with the medium and the lighter classes of production has shown some improvement, and enjoys brighter prospects for the present year. The improved conditions which have been experienced by the motor car industry have been reflected in a good demand for the special quality steels and materials it consumes. Textile machinery makers have not been well employed though the depression in the cotton industry has been, to some extent, offset by the success which has attended the production of artificial silk. The electrical engineering section of the trade began the year with a fair amount of work in hand, but failed to maintain a steady volume of business. The year opened to the accompaniment of increased orders, especially for generating plant and from certain sections of the industrial market, but many important schemes which were expected to materialise still remain in suspense, owing to difficulties in regard to the necessary reorganisation in connection with the supply of electricity occasioned by the provisions of the new Act. In some of the small and newer industries there was a measure of activity owing to the extension of equipment, but, the report states, that it cannot be said that the process of electrification in industrial production showed much progress during 1927. Those sections of the industry engaged on domestic and small supply material were active. There was an unfortunate depression almost throughout the world in connection with the demand for electrical equipment subsequent to the month of August, but existing signs of an improvement in the world market led to the belief that the position will improve during the present year.

Engineers and the French Tariff.

The report discusses in the following terms the new French tariff in relation to the exports of British engineering products: "The Executive has noted with regret the terms of the proposed new tariff as affecting the importation of engineering products into France. Heavy increases in the rates have been notified. Whilst the original intention of the French Government to bring the new tariff into force has not materialised, the concluding of the recent Franco-German agreement has had the direct effect of greatly increasing the rates on imports from Great Britain. The taxes upon the products enjoying most-favoured-nation treatment from France have been automatically brought into line with those embodied in that agreement. Inasmuch as the rates contained in the latter have been based upon the terms and classification of the proposed new tariff, exporters of engineering products from this country have suffered accordingly. Strong representations have been made by the Chamber, and efforts to secure an improvement in the situation will be continued energetically."

More Russian Orders?

Rumours of the placing of further substantial orders with Lancashire engineering firms for textile machinery for Russia have been pretty frequent during the last few days, but so regular have statements to that effect been made within the past year that little credence would be given to anything short of an official announcement on the subject. The most that can be said definitely and authoritatively at the moment is that several of the leading makers of textile machinery in this area are hopeful of securing big orders from Russia during the present year.

New Mersey Dock.

Lever Brothers, Ltd., are to seek parliamentary sanction for an extension of time for the completion of their new dock at Bromborough, on the river Mersey. Originally the firm secured powers in 1923, and a period of five years was allowed for completion. The work, however, has been delayed through various causes, and is not expected to be finished before the second half of next year. As a precautionary measure, the firm is asking for the powers to be extended to 1935. The cost of the dock and the necessary equipment is expected to reach a total of something like £1,000,000, the cost of the dock itself being in the neighbourhood of £750,000.

Personal.

Mr. H. A. Reed, the chief engineer of the Manchester Ship Canal Company and a member of the Council of the Institution of Civil Engineers, is leaving this country shortly on a visit to Egypt to advise the Egyptian Government on river navigation problems. Mr. Reed has been responsible for the design of much of the modern equipment in operation on the Manchester Ship Canal, and notably of the new coal-conveying plant at Ellesmere Port.

Non-ferrous Metals.

After a series of steady declines that set in about six weeks ago, tin has experienced a welcome recovery during the past week and values at the time of writing are roughly £5 a ton better than at last report, although still well below the level of a fortnight ago. For the time being it is not unlikely that the drop in values has about reached its limit. Much of the business now going on in this section of the non-ferrous metals market is, of course, still largely of a speculative character, with the important distinction that the "bulls" seem to be getting the upper hand. With regard to copper, the demand for the metal from home users has been on a fair scale, cable makers, in particular, coming into the market for moderate quantities. Prices in this section, after a slight loss a week ago, have gone farther ahead and continued strength is being shown. In spite of a very moderate demand for lead from consuming interests, quotations have been maintained at about the level ruling for the past three weeks, and on balance current quotations are the same as at the time of my last report. Spelter keeps steady on a fair inquiry for the metal from users, and holders are not apparently over-anxious to sell.

Iron.

Whilst there are still producers who express themselves as reasonably satisfied with the trend of developments, others are keenly disappointed that the hopes inspired by the slight spurt of a week ago have not been fulfilled. The demand at the moment is certainly on quiet lines, taking the market as a whole, and makers are largely concerned just now in preventing prices from registering a further fall. This they are moderately successful in doing, but only with difficulty, for not only are they faced with the problem of increasing stocks at the blast-furnaces, but offers of the metal at cut rates are being met with from several directions. Derbyshire No. 3 iron is usually quoted for delivery to works in this district at about 73s. per ton, Staffordshire brands being at 72s. 6d., Middlesbrough at 78s., Scottish at 87s. 6d. to 88s., and hematite iron at about 85s. per ton. In spite of a continued poor trade in manufactured iron, Lancashire bar makers are maintaining their prices, Crown quality bars being quoted here this week at £10 per ton and seconds at £9 10s.

Steel.

Constructional engineers are fairly actively engaged on work already on their books, although there seems to be a definite lull in fresh inquiry in this branch of engineering. As with most other steel consumers in the

district, they are ordering material on a strictly hand-to-mouth basis, without venturing far ahead in respect of contract business. There is no change in the position of ship and tank plates, which are quoted at the Association price of £8 7s. 6d. per ton, or in joists and sections at £7 12s. 6d. A quiet demand for bars is reported, with small re-rolled materials selling at from £7 7s. 6d. to £7 10s. per ton, and larger diameters at about £8 10s. Basic boiler plates are still being quoted here at from £9 15s. to £10 per ton, and acid sorts at £10 5s. to £10 10s., depending upon the size of the prospective business. The limited buying that is going on in the imported steel department is the subject of keen competition from stockholders, and continental works that are selling direct on this market are not finding it easy to keep prices up. For delivery to Lancashire buyers' works, sections are quoted at £5 2s. 6d. per ton, steel bars at £5 17s. 6d., Siemens plates at £7 10s., Thomas plates at £7 to £7 2s. 6d., billets at £4 18s. to £5, and sheet bars at £5 2s. 6d.

BARROW-IN-FURNESS.

Hematite.

There are no further signs of an improvement in the hematite pig iron trade in this district, but still there is an undercurrent of optimism—a sort of feeling that the iron trade has got down to the lowest, and that, within the next few years, there will be a return to better trade. Inquiries certainly point to such an improvement taking place, but it is too early to be really definite on the matter as yet. Fortunately, the steel works in Barrow and Workington are requiring heavy deliveries, and that certainly has been the means of keeping furnaces going. The Midlands and Scotch customers are taking the heaviest tonnage, South Wales not being a big customer at present, but it may improve. Foreign trade is small. The iron ore trade remains about the same, and deliveries are mostly of local account, though a certain percentage is going on in the district, which may in the next month or two, increase to some extent. Arrivals of foreign ore continue, and there have been heavy imports at Workington this week, close upon 20,000 tons arriving. This heavy delivery coincides with the high tides, which permit a fairly large tonnage to arrive at that port.

Steel.

The steel trade continues to be fairly well employed, and it looks as if both Barrow and Workington were assured of continuous work until about the end of March. At Barrow, the rail, merchants, Siemens and hoop departments are working. At Workington they are engaged upon railway material for South America, the Colonies and home. The steel market is not very bright though, and it is hoped that fresh orders will come to hand in the early future, in order to ensure continuity of production.

SHEFFIELD.

(From our own Correspondent.)

Condition of the Steel Trade.

THERE appear to be some evidences of revival in the steel trades, but the process is a slow one. So far, it has scarcely touched the crude steel branch in this district, and it is not very noticeable even in those special classes of steel of which Sheffield is the principal producer. Both locally and in Lincolnshire the basic steel department is experiencing a very unsatisfactory month. Production is on a very restricted scale, and orders and inquiries are alike scarce. A better report comes from the acid steel side, where the open-hearth furnaces are fairly well employed. In the finished trades the aggregate output is large, but is considerably below the capacity of the plants. A fair amount of railway work is in progress, and it is expected that it will be increased shortly, as the time is coming when substantial contracts should be placed by the home companies. The rolling mills are dealing with a large tonnage of material, but are not fully employed. The city's provision of rod mills is on a large scale, and a great increase of trade will be needed to cause an all-round activity in them. There is much depression with regard to rolled steel of the lower grades, bar iron and wire rods. The call for tool steel is at a poor level, and there is little buying of the ferro-alloys that are used in the production of that material. There is a moderate sale for engineers' tools, and makers are hoping to gain an advantage from the reported improvement of the machine tool trade in Lancashire. The branches making special steel for automobile and aeroplane construction continue to book large orders, though not on the full scale that they have been accustomed to. The progress of stainless and rustless steel for a great variety of purposes is well maintained.

Waterworks Matters.

The Derwent Valley Water Board has placed an order with the South Durham Steel and Iron Company for upwards of 7000 tons of 47in. steel pipes. The Ashton, Stalybridge and Dukinfield (District) Waterworks Committee is emptying its Walker Wood reservoir, in the Brushes Valley, Stalybridge, in order that a valve, which has been in use for more than half a century, may be replaced. The reservoir is the largest of four in the Brushes Valley, and is the third largest belonging to the Committee. It is 61ft. deep and has a capacity of upwards of 202,000,000 gallons. It is being drained at the rate of about 5,000,000 gallons per day, and the water is passing into the river Tame, which runs through Stalybridge.

Derwent and Welland Bridges.

Further information is now available with regard to the condition of the Leadmill Bridge over the Derwent at Hathersage, which was damaged by the recent floods. Divers have made an examination and have found that the concrete foundations upon which the piers were built have been washed away. In all probability the new portion of the bridge will have to be reconstructed. The new bridge over the river Welland, at Spalding, which has cost over £30,000, was opened for traffic on Monday. It will facilitate access to the new sugar beet factory and also provide a through route to the Midlands and the Lincolnshire seaside resorts. It is a steel structure, resting on reinforced concrete. It has two leaves which open for shipping on the Welland, and which can be operated either electrically or manually. It had been hoped that the bridge would be opened last year, but the construction was delayed owing to difficulties caused by quicksands in the bed of the river.

Cutlery and Plate.

The year has opened fairly well in the cutlery trade. For the cheaper classes of goods demand is on a high level, and in the trade as a whole there is more work on hand than is usual in January. The Admiralty is asking for tenders for 100,000 one-piece table knives and 1200 pairs of carvers. A good sale is reported for spoons and forks and cased goods of medium price. There has not yet been a full resumption of the manufacture of electro-plated hollowware, but authorities in the trade consider that the prospects for high quality goods are much better than those of a year ago.

A Managing Director on Safeguarding.

The future of the steel trade is referred to by Mr. F. C. Fairholme, managing director of Thos. Firth and Sons, Ltd., in the current issue of the works magazine, the *Bombshell*. He says that the past year has shown some improvement in the case of several of the firm's departments, especially at Tinsley works, but the heavier side of their trade has been of a very hand-to-mouth character, and foreign competition has kept the prices obtainable at a very low level out of proportion to the heavier charges in the way of transport, national and local taxation, &c., which has to be borne by British manufacturers. "The fact," he continues, "that during the year 1927 no less than about 4,400,000 tons of foreign iron and steel were imported, instead of being made in this country, surely forms a striking comment on the depressed conditions and unemployment in our metallurgical and colliery industries, which causes many thoughtful minds to question whether it would not be wiser to safeguard, at least temporarily, those British industries by a duty on imports of iron and steel in the same manner which has been so successful in the case of the British motor car trades."

Tram and Omnibus Developments.

During the past twelve months the Sheffield Corporation has carried out several important extensions of its tramway and motor omnibus service, and further developments are in prospect. Owing to the growth of population in the Intake district, a tram track has been constructed on the Prince of Wales-road, and it will be opened for traffic within the next few weeks. Good progress has been made with the erection of a large tramway depôt and omnibus garage at Tenter-street, in the centre of the city, and the tramway portion will be brought into use in a few months. Successful experiments have been made with the six-wheeler double-deck type of motor omnibus, and it is intended to make greater use of this type, and also of the low double-deck top-covered type of vehicle. Certain cars have been fitted with upholstered seats, and fifty more of this class are to be put on the road as soon as they can be built.

NORTH OF ENGLAND.

(From our own Correspondent.)

Shipyard Deal.

THE shipyard of the Tyne Iron Shipbuilding Company at Willington Quay, which has a history extending over three-quarters of a century, has been acquired by Sir W. G. Armstrong, Whitworth and Co., Ltd. In recent years the yard has been thoroughly modernised and equipped with the most efficient plant and machinery for the construction of vessels up to 400ft. in length, and some 8000 tons deadweight. In normal years the yard employed about 700 men, and produced an output of some 20,000 tons gross per annum, and it is confidently hoped that under the control of Armstrong, Whitworth and Co. its past activities will be speedily revived, and that work will be found for an increasing number of men as new vessels are laid down. The company announces that active building will commence immediately the repairs and the installation of new machinery are completed, under the charge of Mr. A. Thompson, M.I.N.A., who was previously manager for the Tyne Iron Shipbuilding Company.

Cleveland Iron Trade.

Although business at the moment rules on quiet lines, the inquiries circulating are large, and cover a wide area, and the feeling of optimism which has characterised the market for some weeks past is unabated. The spring demand promises to be on a good scale. So far this year most of the business put through has been with home consumers, but some slight improvement in overseas trade is reported, and there are signs of further growth of export demand. The situation generally may be described as healthy, and conditions in America, as well as on the Continent, should help to strengthen the position of the Cleveland market. Makers' fixed prices for Cleveland iron are very firm, and customers, realising that the next movement in quotations is more likely to be upward than otherwise, are disposed to discuss forward business more freely. The limited quantity of iron available for the open market after makers have made provision for their own consuming plant is well taken up, and in some cases makers are having to draw upon their already heavily depleted stocks in order to fulfil orders. Business with Scotland shows gratifying improvement, and home consumers at a distance are inclined to draw larger supplies from this area. But for the determination of the Cleveland ironmasters to eliminate foreign competition in the home market the possibility of an upward trend in prices would certainly harden. No. 1 Cleveland foundry iron is 67s. 6d.; No. 3 G.M.B., 65s.; No. 4 foundry, 64s.; and No. 4 forge, 63s. 6d.

Hematite Pig Iron.

Buyers of East Coast hematite pig iron are taking up larger supplies, but purchases are chiefly of the hand-to-mouth kind, and makers complain that ruling rates are substantially below cost of production. Nearly all sales are of iron manufactured to analysis to suit the requirements of buyers, but the basis of quotations on the price of mixed numbers at 69s. 6d.

Ironmaking Materials.

There is a continued absence of business in foreign ore, but sellers are not disposed to reduce prices. The strike of ore miners in Sweden is reported to be spreading, and it does not need to be of long duration to hamper seriously consumers in this district. Market rates are still based on 21s. per ton for best Rubio ore c.i.f. Tees. Makers of blast-furnace coke endeavour to take a firmer stand, but ironmasters are still unwilling to negotiate for extensive supplies, and good medium qualities remain about 17s. 6d. per ton delivered at the works in this area.

Manufactured Iron and Steel.

The output of manufactured iron and steel continues on a heavy scale. Greater activity at the shipyards has created more demand for plates, angles and rivets, and railway material is in better request, but steel for the constructional engineering trade is in rather quieter demand. Quotations are steady and unchanged.

The Coal Trade.

The Northern coal trade shows a steadily improving tendency, and the outlook is more encouraging than for some months past. Colliery fitters in every grade of coal are quoting firmly, and report the position to be satisfactory. In the majority of cases they are well booked ahead, especially up to the middle of next month, and during this period there is still an unsatisfied demand, and buyers eagerly seek supplies even at maximum recent values. For more forward positions there is an active inquiry, but owing to the firmly quoted prices, buyers are inclined to hold off, but the outlook gives operators every confidence, and failing securing full prices, they also prefer to hold off, believing that the present strong demand will be continued and overflow into later dates of shipment. Leading Northumberland steams direct are unchanged at 14s., and through contractors 13s. 6d. is a steady quotation. Tyne primes keep to about 13s., and seconds to 12s. Steam smalls are offered freely at 8s. 6d. to 10s., according to brand. Durham steams of all descriptions show no fluctuation. Large smalls and nuts are all moving off well at late prices. Gas coals are variously circumstanced. Some of the pits have strong order books, but others are experiencing less inquiry. Values, however, are undisturbed. Best qualities are selling at about 15s. 6d., and specials at from 15s. 6d. to 16s. 3d. Secondary grades command from 13s. 6d. to 14s. The coaling stations are taking more bunker fuel just now, and for ships' use there is a fairly quick demand. The superior makes are getting most trade at 14s. to 15s. Other kinds are 13s. 6d. to 13s. 9d. The demand for coking coal, which has been a strong feature for some time, is not so pronounced, but prices are well maintained. A colliery sale was made this week for 30,000 tons of good class Durham coking unscreened coals for shipment up to June at 13s. 6d. f.o.b., while a firm of merchants has contracted with a Ghent firm to supply 60,000 tons, shipment in monthly parcels, at a price stated to be 12s. 9d. per ton f.o.b. The coke market is rather quiet, but makers have ample business in hand, and only moderate supplies are available up to the middle of next month, and values are firmly held. Gas coke is quoted at 23s.; good patent coke, 17s. 6d. to 18s. 6d.; special makes and beehive, 24s. to 28s.

Armstrong Contract.

Sir W. G. Armstrong, Whitworth and Co., Ltd., have secured an order for two Canadian Lake steamers for the Mathews Steamship Company, of Toronto, the principal dimensions being:—253ft. by 43ft. 6in. by 21ft. 6in. depth moulded, and the total deadweight 2350 tons on 14ft. draught. The vessels are of the single deck type, with poop and forecastle, and will be fitted with two masts, two derrick posts, and four derricks, also steam windlass, six steam winches, and steering gear of the Wilson-Pirril type. The vessels are to be fitted with single-screw propelling machinery at the after-end, steam being supplied by two single-ended boilers.

SCOTLAND.

(From our own Correspondent.)

Dull Tone.

WHILE it is hoped that ere long conditions may show a decided change for the better, the present position of the steel, iron and coal markets is far from satisfactory. Buyers of almost all classes of material are moving most cautiously, and with the year 1928 now almost four weeks old, there is as yet no sign of any change from the conditions ruling in the latter part of last year.

Steel.

The demand for heavy steel is disappointing, and while all the works are again in operation, few are fully employed. Hopes are entertained of an expansion in shipbuilding demands, but meanwhile specifications for plates, &c., are light. It has been mentioned that an important order for steel tube strips, which was competed for by West of Scotland makers, has been placed with German producers, who quoted a much lower price.

Steel Sheets.

There is only a small inquiry for black steel sheets at present, and the heavy descriptions are especially slow. Galvanised sheets are only moderately busy.

Steel-rolling Record.

What is believed to be a world's record in the rolling of steel plates has been set up by David Colville and Sons, Ltd., Clydebridge Works, Cambuslang. During the week ending last Saturday the firm's large plate mill produced materials of a slab weight of 6532 tons and a finished weight of 5200 tons, the latter figure being a record for the rolling of finished plates within one week.

Iron.

The bar iron trade is still rather depressed. Home prices are unchanged, but a good export order might be placed under the normal quotation of £10 per ton f.o.b. Glasgow. Re-rolled steel bars are only a shade better off than iron bars, and here again the export price of £7 per ton might be shaded. The home price of re-rolled steel bars is £7 15s. per ton delivered Glasgow. Business in continental steel and iron is also rather quiet at the moment.

Pig Iron.

The pig iron market is very flat. Despite further restrictions in output supplies are more than ample to meet all demands. Prices are said to have reached rock-bottom under present conditions.

Exports and Imports.

Iron ore to the amount of 8400 tons was discharged at Glasgow, and during the same period 2400 tons of steel and iron arrived. Shipments of steel and iron products amounted to 2200 tons. Small quantities of machinery and steel tubes were also dispatched abroad. At present there are being discharged 2000 tons of phosphates at Glasgow.

Coal.

The Scottish coal market remains firm, owing to restricted outputs, and a slightly better home demand. Collieries are well booked for this month, but there is a decided lack of fresh shipping business, due partly to the higher prices quoted. The feature of the market is the strength of Lanarkshire ells, which have risen in price by about 3s. 6d. per ton within two weeks. Splints are firm, while Lothians and Fifeshire steams are steady. Double nuts are firmest amongst small stuffs. Aggregate shipments amounted to 254,981 tons, against 196,289 tons in the preceding week and 216,619 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

ALTHOUGH to all outward appearances, judging by the prices ruling, no change has taken place in the conditions prevailing in the steam coal trade, the position, nevertheless, is a trifle better. There is plenty of scope for improvement, of course, but at the same time the feeling prevails that there is a slightly better foundation to the market, and a little more activity. Notwithstanding the fact that tonnage has been difficult, and that many collieries have had their arrangements sadly interfered with, owing to steamers being delayed by bad weather, loading operations have been fairly good, and should improve to some extent. It is interesting to note that for the week ending the 20th shipments amounted to over 470,000 tons, that being the highest figure since the end of November last. This level may possibly not be maintained, but, on the whole, shipments for the current month should be better than last month. In addition to the fact that the coal position is a trifle steadier, there has been a firming up in the state of the outward freight market for most directions, and this probably is a greater incentive to buyers to endeavour to cover their requirements on a c.i.f. basis. Apart from the business being treated on behalf of foreign private consumers, there is no really big inquiry on the market, although it is reported that the Andalusian Railways of Spain have bought round about 12,000 tons of large steam coals for delivery by the end of March, while the Portuguese State Railways will be purchasing about 30,000 tons of large and small coals during the early days of February.

Italy and German Coals.

Considerable anxiety was occasioned in coal export circles on this side recently by the statement that Italy and Germany had arranged for a much increased supply of German coals as Reparations. The report was current that the quantity fixed under the programme was 375,000 tons for December last and 605,000 tons for the current month. On the basis of the latter figure, this meant a total per annum of over 7¼ million tons, and it was regarded as inevitable that under such a scheme South Wales would be an extremely heavy sufferer. Since then information has been received which puts a different complexion on the position, but even now the outlook cannot but be regarded as serious. The announcement has been made that the quantity to be taken under the Dawes Scheme would be 420,000 tons for the month of January. Whether that figure will be maintained throughout the year is not known, but on this basis Italy will be taking over 5 million tons of German coals per annum, and but for the Dawes plan the probability is that 3½ to 4 million tons of this supply would have come to this country. It is understood that under the new arrangement Italy will take in 1929 German coals amounting to over 6 million tons.

Coal Trimmers and Tippers.

On the occasion of the annual dinner of the Bristol Channel District Association of Chartered Shipbrokers held at the end of last week, the chairman, Mr. Louis F. Winks, referred to the hours of work at the docks in this district. For years past, he said, efforts had been made to get the men to revert to the pre-war system of working all round the clock, but so far those endeavours had met with no success. In fact, recently the men's representatives put forward the suggestion that, instead of the two broken shifts which operate at present, there should be a return to the system of two continuous day shifts, thus doing away with night work practically. The employers declined to entertain that proposal, for the reason that much good had been done under the broken shift system. The men's representatives, it is understood, have now abandoned their proposal, and Mr. Winks expressed himself as having reason for stating that the trimmers were now willing to return to the method of working round the clock. He added that no doubt the matter involved difficulties, but he thought that the opportunity should not be allowed to pass by, and that if the authorities concerned took up the matter at once something might be done.

Siemens Steel Bars.

It is announced that the quarterly ascertainment of the average price of Siemens steel bars, on which is based the sliding scale operating in the steel bar and tin-plate industries, gives the figure of £5 13s. 0½d. per ton f.o.r. makers' works, equivalent to 5 per cent. above the base rate, or a decrease of 1½ per cent. on the previous quarter. This governs the wage rate for the current quarter, but men in the lower grades are in receipt of the *ex gratia* payment which, in view of the decrease, will probably now be reconsidered.

The Steel Trade.

Speaking at the annual dinner of the South Wales Institute of Engineers at Cardiff at the end of last week, Mr. W. Simons, of Guest, Keen and Nettlefolds, Ltd., referred to the fact that the steel trade was in a deplorable state. He said that hardly any works were operating at more than 60 to 70 per cent. of their capacity, and an enormous amount of material was coming in from the Continent. The causes for depression were beyond the industry's control. For social services alone they paid 4s. per ton more than their competitors, rail rates were 5s. to 7s. 6d. above those on the Continent, where new works had been built out of the Reparation money, and in Germany the whole of debentures in concerns had been wiped off as a loss. The dumping of steel in the United Kingdom resulted in works operating on short time, which added another 10s. a ton to costs.

Current Business.

The market continues to display no alteration so far as prices are concerned. This applies to both large and small coals, but, of course, the individual position of collieries varies considerably. It depends very largely on the supply of tonnage at hand, and, of course, the movement of steamers has been materially interrupted by bad weather. The firmest spot in the market has undoubtedly been that for washed coals. The demand continues to be very good, but so far as patent fuel is concerned the tone is quiet, though coke for inland requirements has moved off very well. The anthracite coal market rules quiet, except that sized qualities are very steady. Pitwood is easier round about 27s.

LAUNCHES AND TRIAL TRIPS.

SEA BELLE II., yacht; built by J. Samuel White and Co., Ltd., to the order of the Crown Agents for the Colonies; dimensions, 200ft. by 33ft. 6in. by 16ft. Engines, triple-expansion, 11¼in., 18in., 29in. diameter by 24in. stroke, pressure 180 lb.; constructed by the builders; trial trip, January 3rd.

GULLPOOL, steamer; built by Cowper Dry Docks and Shipbuilding Company, Ltd., to the order of Sir R. Ropner and Co., Ltd.; dimensions, 420ft. by 53ft. 6in. by 29ft. 5¼in.; 8650 tons deadweight. Engines, triple-expansion, 26in., 46in., 71in. diameter by 48in. stroke; constructed by Blair and Co. (1926), Ltd.; launch, January 5th.

DAFILA, steamer; built by D. and W. Henderson and Co., Ltd., to the order of the British and Continental Steamship Company, Ltd.; dimensions, 290ft. by 43ft. by 28ft. 3in. Engines, triple-expansion, 21in., 36in., 59in. diameter by 39in. stroke, pressure 200 lb.; constructed by the builders; trial trip, January 10th.

PARRACOMBE, steamer; built by William Gray and Co., Ltd., to the order of Pyman Brothers, Ltd.; dimensions, 419ft. 6in. by 54ft. 2¼in. by 27ft. 6¼in. Engines, triple-expansion, 26¼in., 44in., 73in. diameter by 48in. stroke, pressure 180 lb.; constructed by the builders; trial trip, January 11th.

BRITISH LOYALTY, oil tank motor vessel; built by Palmer's Shipbuilding and Iron Company, Ltd., to the order of the British Tanker Company, Ltd.; 10,000 tons deadweight. Engines, single-screw Diesel; constructed by the builders; trial trip, January 12th.

"CHESAPEAKE," oil tank vessel; built by Workman, Clark and Co., Ltd., to the order of the Anglo-American Oil Company, Ltd.; dimensions, 470ft. by 63ft. 6in. by 34ft. 9in. Engines, eight-cylinder, single-acting, two-cycle Diesel; constructed by the builders; trial trip, January 16th.

"KING EGBERT," motor cargo vessel; built by Harland and Wolff, Ltd., to the order of the King Line, Ltd.; dimensions 400ft. by 54ft. 6in. by 34ft. 8in.; 4534 gross tonnage. Engines, six-cylinder, four-cycle, single-acting Diesel; constructed by the builders; trial trip, January 17th.

"SIDI-AISSA," screw steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Société Générale de Transports Maritimes à Vapeur, of Marseilles; dimensions, 340ft. by 43ft. Engines, triple-expansion; trial trip, January 18th.

"NIMODA," single-screw steamship; built by Harland and Wolff, Ltd., to the order of the Hain Steamship Company, Ltd.; dimensions, 421ft. by 55ft. 9in. by 35ft. 9in.; 4735 gross tonnage. Engines, triple-expansion, 27in., 44in., 73in. diameter by 48in. stroke, pressure 200 lb.; constructed by the builders; trial trip, January 19th.

"TOFTWOOD," steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Joseph Constantine Steamship Line, Ltd.; dimensions, 375ft. by 52ft. 6in. by 27ft. 9in. Engines, triple-expansion, pressure 200 lb.; constructed by the builders; trial trip, January 20th.

CALENDARS, DIARIES, &c.

JOHN A. SMEETON, Ltd., 15, Victoria-street, S.W. 1.—Desk calendar from the Demag Company, Duisburg, with daily slips.

SUTCLIFFE BROS. AND BRYCE, Ltd., Globe Works, Hyde.—Pocket diary.

WELBECSON PRESS, Ltd., 108–110, Clarendon-road, W. 11.—Wall calendars with monthly tear-off sheets.

ED. WOOD AND CO., Ltd., Ocean Ironworks, Manchester.—Wall calendar with monthly tear-off sheets.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. ROGER PRESTON asks us to announce that he has moved his offices from 104, High Holborn, to 7, Southampton-street, Bloomsbury-square, London, W.C. 1.

LINDLEY DUFFIELD AND CO., Ltd., ask us to announce that they have removed from their old offices at 11, Aldwych, London, W.C. 2, to Imperial House, Kingsway, W.C. 2. Their new telephone numbers are Gerrard 0351–2.

MR. C. E. SHANN, A.M.I. Mech. E., M.I.E.I., late of Sir W. G. Armstrong, Whitworth and Co., Ltd., asks us to announce that he has commenced business at No. 5, Victoria-street, Westminster, as an inspecting engineer of plant and materials.

HIGH DUTY ALLOYS, Ltd., asks us to announce that it has purchased from the Receiver of Peter Hooker, Ltd., the aluminium alloy business of that company, and that it intends to carry on that business at new works on the Trading Estate, Slough, Bucks.

WE are asked to say that Gossell and Son, Ltd., of 110, Cannon-street, London, E.C. 4, are the sole representatives in this country for Messrs. Henschel and Sohn, of Cassel, who constructed the Schmidt-Henschel locomotive, described in our last issue, to the requirements of Dr. Wagner and the Superheater Company, Ltd.

RUTHS STEAM ACCUMULATORS, Ltd., of Africa House, Kingsway, W.C. 2, asks us to announce that Fairfield-Howden Ruths Steam Accumulators, Ltd., has now completed the work for which it was formed, and that a new company has now been formed to pursue and extend on a large commercial scale the construction and use of steam accumulators in all parts of the British Empire. The board of the new company, Ruths Steam Accumulators, Ltd., is as follows:—Chairman, Mr. F. E. Powell; directors, Sir Alexander Kennedy, Dr. Johannes Ruths, and Messrs. J. B. E. Dahlerus, J. Howden Hume, W. S. Eyre, and A. J. T. Taylor, the last named being also managing director.

THE INSTITUTE OF TRANSPORT.—A meeting will be held at Dowell's Rooms, 18, George-street, Edinburgh, at 7.30 p.m., on Tuesday, February 14th, to initiate a Scottish Section of the Institute of Transport. The President, Mr. Rogert T. Smith, who will be accompanied by the Secretary, will attend the meeting and deliver an address.

INSTITUTION OF NAVAL ARCHITECTS.—The annual meetings of the Institution of Naval Architects will take place on Wednesday, March 28th, and the two following days, in the Lecture Hall of the Royal Society of Arts, John-street, Adelphi, W.C. 2. The annual dinner will be given on Wednesday, March 28th, at 7.30 p.m., in the Grand Hall, Connaught Rooms, Great Queen-street, Kingsway, W.C.

BITUMINOUS COAL.—The Carnegie Institute of Technology announces that a second international Conference on Bituminous Coal is to be held at Pittsburgh, Pa., between November 19th and 24th. The purpose of the Congress is similar to that of one held in 1926 by the Carnegie Institute of Technology: to present the results of recent studies of coal that have to do with improved methods of utilisation and combustion. The programme will include the discussion of the fixation of nitrogen, the manufacture of substitutes for petrol from coal, complete gasification of coal, high-temperature distillation, low-temperature distillation, coal tar products, power, smokeless fuel, &c. An invitation is extended to scientists of all countries to take part in this Conference.

FARADAY MEDAL.—The Council of the Institution of Electrical Engineers have made the seventh award of the Faraday Medal to Professor J. A. Fleming, M.A., D.Sc., F.R.S., honorary member of the Institution. The Faraday Medal is awarded by the Council of the Institution not more frequently than once a year, either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science without restriction as regards nationality, country of residence, or membership of the Institution. Professor Fleming, who is well known as the inventor of the first wireless valve, was Professor of Electrical Engineering in the University of London from 1910 until his retirement in 1927, and has played a notable part in the development of a great many applications of electrical science.

ASSOCIATION OF CONSULTING ENGINEERS: ANNUAL DINNER.—The annual dinner of the Association of Consulting Engineers was held on Monday evening last at St. Stephen's Club, Westminster. As usual, it was a most delightful affair. These annual gatherings have always been noted for good speeches, and the present occasion proved to be no exception to the general rule, for the orations—some of them more than earned that description—were, practically all of them, of a more than usually high order. True—as was several times remarked by speakers during the evening—the subjects dealt with and the stories told were not always entirely relevant to the matter immediately in hand. But that did not matter. It was not a formal gathering, but a festive occasion, and they—and perhaps we should add, too, the excellence of the fare provided—certainly had the effect of putting all present—members and guests alike, and there were many of the latter—on thoroughly good terms with themselves and with all the world.

POLISH NATIONAL EXHIBITION.—A universal national Exhibition is to be held in Poland in 1929 to commemorate the tenth anniversary of the independence of that country. The Exhibition will represent all spheres of the national life of Poland, *i.e.*, of the economic as well as of the cultural, scientific, social and sporting life of the country. Polish emigration will occupy an important place, for a special pavilion has been set apart wherein will be exhibited a graphic display of the cultural, economic and political achievements of Polish emigrants, especially in North America and Brazil. The Exhibition will have support of the Government, the President of the Republic having consented to become a Patron, and Marshal Pilsudski, the Prime Minister, having accepted the presidency of the honorary committee. It will also offer many illustrations of Poland's participation in international trade and commerce, the possibilities of expanding her exports and imports, as also her commercial relations with other European countries, including Great Britain.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	21/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 14 0	—
No. 1 Foundry	3 15 0	—
No. 3 Foundry	3 10 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 9 6	3 9 6
No. 1	3 10 0	3 10 0
Cleveland—		
No. 1	3 7 6	3 7 6
Silicious Iron	3 7 6	3 7 6
No. 3 G.M.B.	3 5 0	3 5 0
No. 4 Foundry	3 4 0	3 4 0
No. 4 Forge	3 3 6	3 3 6
Mottled	3 3 0	3 3 0
White	3 3 0	3 3 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 4 6 to 3 6 0	—
(3) Northampton—		
Foundry No. 3	3 0 0 to 3 1 0	—
Forge	2 14 0	—
(3) Derbyshire—		
No. 3 Foundry	3 4 0 to 3 6 0	—
Forge	2 19 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 4 0 to 3 5 0	—
No. 4 Forge	3 2 6	—
Basic	3 2 6	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 2 0 (a) / 4 5 0 (b) / 4 8 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	10 0 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
LANCS.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	12 10 0	—
S. YORKS.—		
Crown Bars	10 10 0	—
Best Bars	11 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 2 6 to 10 5 0	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0	—
Gas Tube Strip	11 10 0	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¾in. and up	8 2 6	7 12 6
Sections	7 12 6	7 2 6
Steel Sheets, ¼in.	8 12 6	8 15 0
Sheets (Gal. Cor. 24 B.G.)	13 12 6	13 7 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	7 10 0 to 10 0 0	—
MANCHESTER—		
Bars (Round)	8 10 0	—
,, (Small Round)	7 10 0	—
Hoops (Baling)	10 5 0	10 0 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 7 6	—
,, (Lancs. Boiler)	10 5 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 12 6 to 8 2 6	—
Intermediate Basic	7 10 0	—
Soft Basic	6 10 0	—
Hoops	9 10 0 to 10 10 0	—
Soft Wire Rods	9 0 0	—
MIDLANDS—		
Small Rolled Bars	7 7 6 to 8 0 0	—
Billets and Sheet Bars	6 0 0 to 6 5 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 0 0 to 13 5 0	—
Angles	7 12 6	—
Joists	7 12 6	—
Tees	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/- to 18/3
Block Tin (cash)	251 15 0
,, (three months)	250 5 0
Copper (cash)	62 16 3
,, (three months)	62 11 3
Spanish Lead (cash)	21 15 0
,, (three months)	22 3 9
Spelter (cash)	26 5 0
,, (three months)	26 3 9
MANCHESTER—	
Copper, Best Selected Ingots	66 17 6
,, Electrolytic	67 10 0
,, Strong Sheets	92 0 0
,, Tubes (Basis Price), lb.	0 1 0¾
Brass Tubes (Basis Price), lb.	0 0 11¼
,, Condenser, lb.	0 1 1¼
Lead, English	23 7 6
,, Foreign	22 10 0
Spelter	26 7 6
Aluminium (per ton)	£107

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£22 17 6	7/3
,, ,, 8 p.c. to 10 p.c. ,,	£22 10 0	6/6
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£36 0 0	11/6
,, ,, ,, 1 p.c. carbon	£41 10 0	15/-
,, ,, ,, 0·70 p.c. carbon	£53 0 0	17/6
,, ,, ,, carbon free	1/4 per lb.	
Metallic Chromium	3/- per lb.	
Ferro Manganese (per ton)	£13 0 0 for home, £12 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 15 0 scale 5/- per unit	
,, ,, 75 p.c.	£20 5 0 scale 6/- per unit	
,, Vanadium	14/3 per lb.	
,, Molybdenum	5/- per lb.	
,, Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£175	
Ferro-Cobalt	9/- per lb.	

FUELS.

SCOTLAND.
(Prices not stable.)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/3
,, ,, Ell	17/-
,, ,, Splint	17/6 to 18/-
,, ,, Trebles	14/6
,, ,, Doubles	14/6
,, ,, Singles	11/9 to 12/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/3
,, ,, Jewel	15/6
,, ,, Trebles	14/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/- to 13/-
Screened Navigation	18/-
Trebles	14/9 to 16/-
Doubles	14/3 to 14/6
Singles	11/9
LOTHIANS—	
(f.o.b. Leith)—Best Steam	12/9
Secondary Steam	12/3
Trebles	14/6
Doubles	14/6
Singles	11/9

ENGLAND.

	Inland.
(8) N.W. COAST—	
Steams	24/- to 25/-
Household	37/6 to 50/-
Coke	23/6
NORTHUMBERLAND—	
Best Steams	13/9 to 14/-
Second Steams	12/6 to 13/-
Steam Smalls	10/-
Unscreened	13/- to 13/6
Household	21/- to 27/-
DURHAM—	
Best Gas	15/6
Second	13/9 to 14/-
Household	21/- to 27/-
Foundry Coke	19/- to 26/-
SHEFFIELD—	
Best Hand-picked Branch	27/6 to 29/6
Derbyshire Best Bright House	20/6 to 21/6
Best House Coal	19/- to 20/6
Screened House Coal	16/- to 17/6
,, ,, Nuts	15/- to 16/-
Yorkshire Hards	14/6 to 15/6
Derbyshire Hards	14/- to 15/6
Rough Slacks	8/6 to 9/6
Nutty Slacks	6/- to 7/-
Smalls	3/- to 4/6
Blast-furnace Coke (Inland) 13/- at ovens	
Furnace and Foundry Coke (Export), f.o.b.	17/6 to 18/-

(9) SOUTH WALES.

CARDIFF— Steam Coals :	
Best Smokeless Large	19/- to 19/6
Second Smokeless Large	18/6 to 19/-
Best Dry Large	18/3 to 18/9
Ordinary Dry Large	17/6 to 18/-
Best Black Vein Large	17/3 to 17/6
Western Valley Large	17/- to 17/3
Best Eastern Valley Large	17/- to 17/3
Ordinary Eastern Valley Large	16/6 to 17/-
Best Steam Smalls	12/6 to 13/-
Ordinary Smalls	11/- to 12/6
Washed Nuts	18/- to 22/6
No. 3 Rhondda Large	20/- to 20/6
,, ,, Smalls	14/9 to 15/3
No. 2 ,, Large	16/- to 16/6
,, ,, Through	14/6 to 15/6
,, ,, Smalls	12/6 to 13/6
Foundry Coke (export)	30/- to 37/6
Furnace Coke (export)	27/6 to 30/-
Patent Fuel	22/6 to 24/-
Pitwood (ex ship)	26/9 to 27/-
SWANSEA— Anthracite Coals :	
Best Big Vein Large	30/- to 32/6
Seconds	25/6 to 29/-
Red Vein	20/6 to 25/-
Machine-made Cobbles	35/- to 40/-
Nuts	38/6 to 42/6
Beans	22/6 to 27/6
Peas	17/- to 18/-
Breaker Duff	8/6 to 9/-
Rubbly Culm	8/- to 8/6
Steam Coals :	
Large	17/6 to 18/6
Seconds	16/- to 17/-
Smalls	10/- to 11/-
Cargo Through	15/- to 16/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 7/6 joists and 5/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(*From our Correspondent in Paris.*)

Coal Duties.

FOLLOWING upon the suppression of licences for the importation of coal the colliery proprietors in the Nord and Est have endeavoured to secure a more definite form of protection by urging the Government to impose higher import duties on fuel. As the Government has so far failed to make any official statement to the effect that it declines to meet the wishes of coalowners, consumers are agitating strongly against the carrying out of any measure which must inevitably raise the price of coal. The unsatisfactory situation of the coalowners is due not so much to foreign competition as to the inferior quality of much of the coal produced. Coal must be imported for gas making and steam raising purposes, and though the consumption of anthracite has fallen off considerably nothing has been found to supersede it entirely. Even during the licence period the northern collieries were obliged to send coal into other districts where coal of an inferior quality was raised, with the result that some of the smaller collieries have already had to close down, and it is feared that if this state of things should continue there will be a notable diminution in the home production. It is alleged that, since the suppression of import licences, there has been wholesale dumping of coal from Germany and Great Britain which is seriously imperilling the French colliery industry. So far as consumers are concerned the alleged dumping is not regarded as an evil, since cheap coal is necessary to an industrial recovery, and as the coalowners took what is regarded as an unfair advantage of their late monopoly to raise prices unduly, they are receiving very little sympathy now. On the other hand, the Government has on several occasions committed itself to a protection of the home colliery industry, and the possibility of something being done which will have the effect of raising prices is viewed with concern.

Hydraulic Works in Africa.

The Congrès de l'Eau, which has just been held in Algiers, marks the beginning of a systematic effort to ensure a distribution of water over vast territories in North Africa that at present suffer from long periods of drought. At certain seasons the rains fall in tropical abundance, sufficient to supply the needs for the entire year if the water could be preserved, and in Algeria a great deal has already been done, by the construction of barrages, to remedy the water shortage. The problem is twofold, one being to store the water which falls on the northern slopes of the Atlas Mountains and is sufficient to provide all that is required for irrigation, and the other to proceed with the work of afforestation on the southern side of the range in the belief that that would produce a certain humidity of climate and therefore render productive otherwise arid soils. The disastrous experience of the past month or two has shown how it is possible for huge masses of water to pour down the *oueds* in a few hours and carry with them devastation in Algeria and Morocco. The object of the Congress was to discuss methods of controlling this water and storing it so as to increase enormously the productive character of the soil, and it is probable that the suggestions put forward will be embodied in a programme of hydraulic works which will minimise the effects of drought over the greater part of North Africa.

Air Service.

It is officially announced that at a very early date the Latécoère Company will initiate an air service between France and Argentina by an extension of the existing line to Dakar to the Cape Verde Islands, and thence by fast boats to the island of Noranha, where passengers and mails will be transferred to aeroplanes and taken to Natal in Brazil. The line between Natal and Rio de Janeiro and Buenos-Aires has been running experimentally for some time. Nevertheless recent events would seem to show that this enterprise is encountering some difficulty. Notably, a fatal accident to one of the aeroplanes on the Natal–Buenos-Aires route is attributed to a criminal tampering with the machine. The Latécoère Company can only preserve its concession by starting the service within a specified date, and there appears to have been some hurry in carrying arrangements through, but as everything is being done to revive the reputation of French aviation the company cannot afford to neglect this opportunity of taking the initiative in the South American service. In the hope of counteracting as far as possible, the German success in Spain, the French are endeavouring to negotiate an arrangement with that country for a more definite air status, while at home there are proposals for the creation of a central organisation, either in the form of an Air Ministry or of a Secretary of State, to give a stimulus to progress in aviation.

Patent Legislation.

For a long while past persons and societies interested in the protection of "industrial property" have been agitating for a reform of the existing patent legislation, and Bills have been drawn up which aim at bringing the laws more into line with those of other countries, notably in a preliminary examination which would give more weight to a French patent than it has at present. A French inventor is not sure of the validity of his patent until it has been sustained in a court of law, often after costly proceedings, and it is merely the fear of that cost and of the heavy penalties that follow infringement that deter most people from attempting to deprive inventors of their rights. A Bill is now passing through Parliament, and will, it is expected, be adopted by the Senate at an early date, whereby some of the more serious grievances are removed. Under the Bill now before the Senate patents will be no longer invalidated through non-working, and what is called the "compulsory licensing scheme," will be instituted. This will apparently affect the situation of foreign patentees, who usually seek to dispose of their patent rights abroad for cash payments, but if everyone is entitled to manufacture, and the Courts have the right to fix the remuneration of inventors, these latter will presumably find their hands tied to a certain extent.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

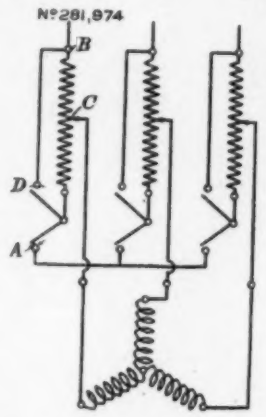
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

281,974. August 9th, 1927.—IMPROVEMENTS RELATING TO THE STARTING OF SINGLE-PHASE AND POLYPHASE ELECTRIC MOTORS BY MEANS OF AUTO-TRANSFORMERS, Ateliers de Constructions Electriques de Charleroi, of 91, Rue de l'Enseignement, Brussels, Belgium.

The invention allows of utilising an auto-transformer not only as an inductance or choke coil at the moment of changing over from half to full voltage by opening the neutral point, but also as a protective inductance during normal running. During the running period the complete winding for each phase A B or a

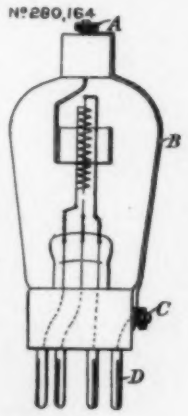


portion of the winding including the tapping point is short-circuited. As the point C is midway between the terminals A and B, the portions B C and A C of each winding are traversed by opposing currents, and the voltage drop due to the auto-transformer is only 2 or 3 per cent. of the normal voltage. When starting the motor the switches are thrown on to the contacts A when the choking coils are connected star-fashion, whilst when the motor is running the switches are transferred to the contacts D when the choking coils are short circuited.—*December 15th*, 1927.

TELEGRAPHS AND TELEPHONES.

280,164. July 4th, 1927.—IMPROVEMENTS RELATING TO THERMIONIC VALVES OR ELECTRON DISCHARGE TUBES, N. V. Philips' Gloeilampenfabrieken, Emmasingel 6, Eindhoven (Holland).

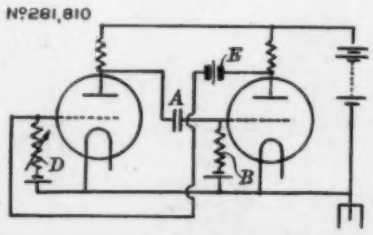
The object of this invention is to reduce the inter-electrode



capacity of a thermionic valve. The anode is connected to a terminal A by means of a wire B, which is connected to another terminal C on the cap of the valve, and this terminal is connected to one of the valve pins D. The other pins are connected to the grid and filament in the ordinary way.—*December 15th*, 1927.

281,810. October 1st, 1926.—ELECTRICAL OSCILLATION GENERATORS, Harold Lister Kirke, of 11, Newburgh-road, Acton, London, W. 4.

This specification describes a novel method of employing

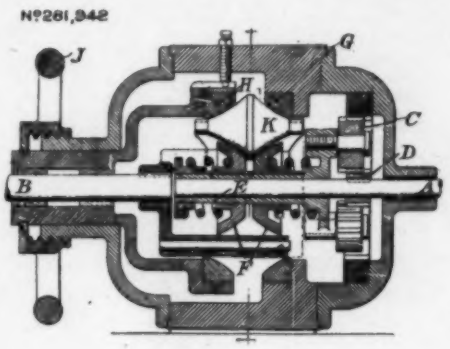


piezo electric devices, such as quartz crystals or other mechanical vibratory devices. The object of the invention is to cause a circuit to produce oscillations at the true natural frequency of the crystal by suitably adjusting the relative phases of the various portions of the circuit. In the example shown, two valves are employed. The anode of the first valve is connected through a condenser A to the grid of the second valve. One leg of each filament is earthed. The grid of the second valve is earthed through a grid leak resistance B, and a grid bias battery. The grid of the first valve is earthed through a variable resistance and D and a battery. To provide the necessary retroactive coupling between the grid of the first valve and the anode of the second valve, these two electrodes are connected together through a quartz crystal E. The variable leak resistance D permits of control of the amplitude and phase of the retroactive impulses, and the more critically these are adjusted, the more constant will be the frequency of the generated oscillations.—*December 15th*, 1927.

TRANSMISSION OF POWER.

281,942. May 17th, 1927.—CHANGE-SPEED GEARING, R. S. Jacobsen, 901, College-avenue, Wheaton, Illinois.

In this gearing the driving shaft is shown at A, and the driven at B. On the driving side there is an epicyclic gear C, worked by the pinion D, which rotates the sleeve E and consequently the conical raceways F F. Within the casing there are a fixed

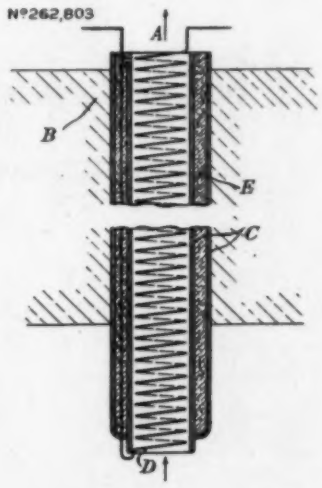


raceway G and a slidably fixed raceway H, which can be moved axially by means of the hand wheel J. Between the raceways there are arranged conical rollers K, which are held in a cage attached to the driven shaft B. It will be seen that the speed ratio of the two shafts is dependent upon the effective position of contact between the rollers K and the raceways, which can be controlled by the hand wheel.—*December 15th*, 1927.

FURNACES.

262,803. December 9th, 1926.—IMPROVEMENTS IN OR RELATING TO BRIGHT ANNEALING FURNACES, *Siemens-Schuckertwerke Gesellschaft mit beschränkter Haftung, of Berlin-Siemensstadt, Germany.*

This specification describes a process for the removal of vapours or vapour mixtures from annealing furnaces. In the drawing



A is a gas outlet passage extending through the wall B of the furnace. The outlet passage is surrounded by insulating material E enclosed between two walls C of fire-proof material. The gas passes through the outlet in the direction indicated by the arrows, and its temperature is maintained above the highest boiling point of the vapours formed in the annealing vessel by an electric heating coil D.—*December 22nd*, 1927.

METALLURGY.

282,306. August 8th, 1927.—PROCESS OF RECOVERING LEAD OR VALUABLE LEAD COMPOUNDS FROM LEAD-SULPHUR COMPOUNDS, *A. L. Mond*, 19, *Southampton-buildings, Chancery-lane, London, W.C.* 2.

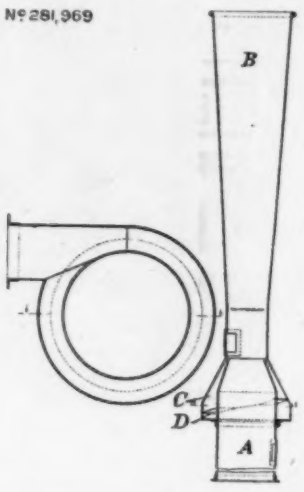
This invention relates to a process of recovering lead or valuable lead compounds from materials containing lead in the form of sulphide or sulphate. In the treatment of sulphide ores containing lead and zinc, or of residues of such ores, it has been proposed to convert the sulphides by known means into sulphates and to heat the resultant mixture with a saturated solution of sodium chloride for about half an hour up to 100 deg. Cent., thereupon to pass the hot solution into a cooling vessel where a mixture of lead sulphate and lead chloride was separated, which mixture was submitted to further metallurgical treatment. This important technical advance is realised in the invention under review by treating the lead sulphate-containing material with a concentrated solution of sodium chloride—or other chlorides capable of reacting on lead sulphate in the same manner—under pressures above atmospheric and at temperatures above 100 deg. Cent. By way of example the invention may be carried out in practice in the following manner:—Commercial lead sulphate—or any other material containing lead sulphate—if necessary or desired, after being cleaned from adhering soluble substances, such as salts, free acid and the like, is agitated with a sufficient or equivalent quantity of a solution of sodium

chloride under a pressure of about four to five atmospheres at a temperature of about 140 deg. and 150 deg. Cent. After the reaction is completed—after, for example, ten to fifteen minutes—the mass is allowed to settle for a short time, whereupon the liquid containing lead is passed under pressure through a heated filter press. On cooling the clear solution from the filter press, pure lead chloride will crystallise out. However, before such crystals separate, the lead content of the solution can be precipitated in metallic form or in form of another lead compound by any suitable known means.—*December 22nd*, 1927.

MISCELLANEOUS.

281,969. July 21st, 1927.—VENTILATING APPARATUS, T. Neilson and J. Marshall, Windsor Engineering Company, 11 to 33, Cogan-street, Pollokshaws, Glasgow.

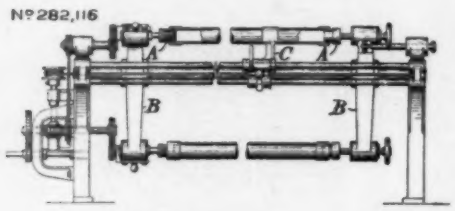
This invention virtually comprises an ejector for ventilating purposes, with a passage of the Venturi type. The ventilating connection is made at A, and the discharge is through the



divergent nozzle B. The impelling air is supplied to the box C by means of a fan, or any other convenient means, and escapes by the annular opening. The peculiarity of the arrangement lies in the fact that this air is delivered to the box tangentially, and is given an upward twist by means of the guide vane D.—*December 15th*, 1927.

282,116. July 17th, 1926.—METAL-SPRAYING PIPES, F. G. Cozens, South Bank, Queens Cross, Dudley, and Metallisation, Ltd., Pear Tree-lane, Dudley.

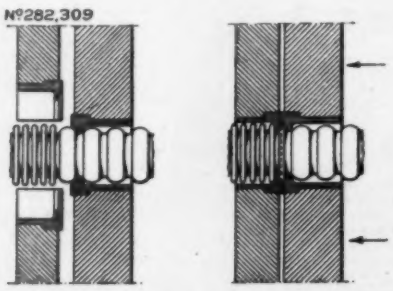
This machine is intended for the metal-spraying of the exterior of pipes. It is explained that three operations are required in the usual metal-spraying process, the first operation being the heating of the tube or pipe to remove any paint, fat or grease, the second operation being the sand blasting of the tube, and



the third operation the metal spraying proper. The pipes are held in chucks A A carried by triform brackets B B, and are rotated by the gearing shown, while the metal-spraying device is travelled longitudinally on the slide C. There are three sheet metal partitions—not shown—between the three pipes. In the bottom position the pipe is heated. It is then turned 120 deg., and is sand blasted. Finally, it is sprayed in the front position. Three pipes are operated upon simultaneously.—*November 17th*, 1927.

282,309. August 20th, 1927.—MANUFACTURE OF CORRUGATED TUBES, A. Dreyer, 3, Villienstrasse, Lucerne, Switzerland.

This invention is concerned with the "manufacture" of corrugated tubes, which have already been provided with preliminary corrugations. The essence of the idea lies in the elec-



trical heating of the material, so that tubes of comparatively heavy gauge can be readily corrugated. The illustration shows the necessary tools, which form the electrodes for the electric current in the positions of starting and finishing the corrugating operation.—*December 22nd*, 1927.

281,944. May 23rd, 1927.—ROLLING THIN METAL PLATES, Grafenberger Walzwerk G.m.b.H., Dusseldorf-Grafenberg, Germany, and F. Holzhausen, Lindenstrasse 196, Dusseldorf, Germany.

Here we are told that as a rule iron plates are rolled hot. With that method packets are formed by superposing plates in order to roll several plates or sheets in one operation. Owing to the heating, the surfaces of the plates becomes so soft that they easily adhere to each other and do not shift relatively to each other during the rolling. As an additional precaution against shifting, it has also been proposed to weld the packets of plates at their edges. The thickness of plate down to which the plates can be rolled hot is limited, and amounts to 0·2 mm., as in the case of excessively thin plates burning easily takes place. In recent times iron plates have also been rolled cold. But only one plate could be rolled at a time, as in the case of simultaneous rolling of several plates, they shifted relatively to each other, formed creases, broke and lifted off each other on leaving the rolls. In that process it was also impossible to obtain very thin plates as the rolls slightly bent through in the middle and therefore could not be set closely enough. The smallest plate thickness obtained amounted to 0·6 mm. According to this invention, very thin iron plates, down to 0·05 mm., may be manufactured, such as could not be economically obtained hitherto, by cold rolling. This is ensured by welding together at the longitudinal edges packets of cold plates, so that the plates lie fast throughout their whole length and stretch practically only in the longitudinal direction. With this method no shifting of the plates or any formation of creases takes place, so that the waste is very small and comprises only the welded together longitudinal edges which may be cut off. Moreover, the packet may be rolled on a three-high mill; that is to say, it can be rolled forwards and backwards, so that the uneconomical carrying back to the front of the rolling mill is eliminated, and time and labour are saved.—*December 15th*, 1927.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

CHEMICAL ENGINEERING GROUP.—Dyers' Hall, Dowgate-hill, London, E.C. 4. Joint meeting with the Society of Dyers and Colourists. "Dry Cleaning and Finishing Machinery," by Mr. A. J. Hatfield. 6.45 p.m.

INDUSTRIAL WELFARE SOCIETY.—Hotel Metropole, Northumberland-avenue, London, W.C. 2. Conference on Accident Prevention. 11 a.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Mappin Hall of the University, St. George's-square, Sheffield. "The Metal Aeroplane," by Mr. J. C. Buchanan. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Applications of Electro-chemical Deposits of Metals to Engineering Purposes," introduced by Mr. C. H. Faris. 7 p.m.

INSTITUTION OF PRODUCTION ENGINEERS.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Presidential address by Sir Alfred Herbert. 7.45 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "Powdered Fuel for Boiler Firing," by Mr. R. H. Allen. 7.30 p.m.

KEIGHLEY ASSOCIATION OF ENGINEERS.—Room 14, Temperance Institute, Keighley. Lecture, "How the Engineer Helps the Navigator," by Mr. T. B. Hyde. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Mining Institute, Newcastle-upon-Tyne. Paper, "Ship Vibration Periods," by Mr. J. Lockwood Taylor. 6 p.m.

PHYSICAL SOCIETY.—Imperial College of Science, South Kensington, London, S.W. 7. Papers: "The Swan Band Spectrum of Carbon," by Mr. W. E. Pretty; "On Some Misapplications of the Law of Errors, and on the Intrinsic Error in Focometry," by Mr. T. Smith; "Some Acoustical Phenomena Illustrated by Ripples—Transmission through Quincke Filters, Curved Conduits and Vibrating Partitions," by Dr. A. H. Davis. 5 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "Prehistoric Cave Art," by Miss D. A. E. Garrod. 9 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.—Room 24, Royal Technical College, Glasgow. Paper, "Researches on Blast-furnace Reactions to Date," by Professor W. A. Bone. 7 p.m.

SATURDAY, JANUARY 28TH.

INSTITUTION OF CIVIL ENGINEERS.—Students' visit to the works of the Westinghouse Brake and Saxby Signal Company, Ltd., York-road, King's Cross, N. 1.

MONDAY, JANUARY 30TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Cantor Lecture, "The Scientific Foundations of the Refining of Petroleum," by Dr. A. E. Dunstan. 8 p.m.

MONDAY TO SATURDAY, JANUARY 30TH TO FEBRUARY 4TH.

BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION.—Glaucus-street Electricity Works, Bromley-by-Bow. Exhibition and Demonstration of Industrial Electric Heating Apparatus. 2 p.m. each day.

WEDNESDAY, FEBRUARY 1ST.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. Paper, "The Design and Distribution of Wireless Broadcasting Stations for a National Service," by Captain P. P. Eckersley. 6 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Paper, "Some Modern Aspects of the Cultivation of Para Rubber," by Mr. C. H. Wright. 8 p.m.

THURSDAY, FEBRUARY 2ND.

INSTITUTION OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Grand Hotel, Sheffield. Seventh annual dinner. 6.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Paper, "Some Practical Considerations in the Design of Automatic Equipments for Heavy Traction Sub-stations," by Mr. H. B. Poynder. 6 p.m.

ROYAL AERONAUTICAL SOCIETY.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Lecture, "Ground Transport for an Air Organisation," by Flight-Lieut. R. E. H. Allen. 6.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "From Faraday's Note Books," by Sir William Bragg. 5.15 p.m.

FRIDAY, FEBRUARY 3RD.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Chamber of Commerce, New-street, Birmingham. Paper, "The Reconstruction of the Wolverhampton-Dudley Road," by Mr. C. O. L. Gibbons. 6 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS: MANCHESTER CENTRE.—College of Technology, Sackville-street, Manchester. Paper, "The Use and Collapsing Tests of Copper Flue Tubes for Locomotive Boilers," by Mr F. Tomlinson. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's-gate, Westminster, London, S.W. 1. Conversazione and reception. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "Automatic Sub-stations," by Mr. D. Kingsbury. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "Photosynthesis," by Professor E. C. C. Baly. 9 p.m.

MONDAY, FEBRUARY 6TH.

SOCIETY OF ENGINEERS.—Geological Society's Rooms, Burlington House, Piccadilly, London, W. 1. Presidential address, "The National Rivers and their Functions," by Mr. C. H. J. Clayton. 6 p.m.

WEDNESDAY, FEBRUARY 8TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "Theatre Lighting," by Mr. H. D. Wilkinson. 8 p.m.

CONTRACTS.

HADFIELDS LTD., of Sheffield, has recently received from New Zealand an order for one of its large cast steel-framed stone-breakers. The weight of the machine is to be 46 tons and its capacity 100 to 120 tons per hour. When installed it will be the largest crushing machine operating in New Zealand.

JOSEPH KAYE AND SONS, Ltd., Lock Works, Leeds, have secured orders for a year's supply of their patented railway carriage door locks and handles from all sections of both the L.M. and S. and L. and N.E. railways, and also have contracts in hand for the Great Western, Union of South Africa, Great Southern of Ireland, and Iraq Railways.

NETHERLAND SHIPBUILDING COMPANY (Nederlandsche Scheepsbouw Maatschappij), of Amsterdam, has received from the Koninklijke Paketvaart Maatschappij an order to build two steam passenger and cargo vessels of 290ft. by 43ft. by 21ft. 3in., with passenger accommodation for twenty-eight passengers first-class and eighteen second-class. The machinery installation of 1600 I.H.P. will be supplied by the Werkspoor Company.

J. W. BROOKE AND CO., Ltd., of Lowestoft, have received the following orders for shipment overseas:—(*a*) Petrol motor direct-current generating sets giving 25 ampères at 100/160 volts, with 10 H.P. four-cylinder "Empire" motor as the prime movers, from Marconi's Wireless Telegraph Company, Ltd., for Singapore; (*b*) 2·5 kW petrol-electric sets for Holland; (*c*) 1 kW and 2 kW sets for East Africa and Sierra Leone; and (*d*) stationary pumping sets for the Kaduna District, West Africa.

THE GREAT WESTERN RAILWAY officially announces that the following contracts have been placed:—(*a*) Supply of forty-two 4-ton motor chassis, seventy-two 30-cwt. motor chassis, and three A6 type chassis—John I. Thornycroft and Co., Ltd., Thornycroft House, Smith square, S.W. 1; (*b*) supply of sixty omnibus bodies—Messrs. Strachan and Brown, Wales Farm-road, W. 3; John Buckingham, Ltd., Bradford-street, Birmingham; Vickers Ltd., Crayford Works, Crayford, Kent; The Weybridge Engineering Company, Black Boy Works, Weybridge; Short Bros. (Rochester and Bedford), Ltd., Rochester; (*c*) overhaul of steam hopper barges "Sir Henry Mather Jackson" and "Foremost VII." and tug "Amy"—Thomas Diamond and Co., Ltd., Bute Docks, Cardiff; (*d*) overhaul of dumb hopper barge "Goldsand" and repairs to No. 7 mooring buoy, Queen Alexandra Dock entrance, Cardiff; and (*e*) overhaul of steam hopper barge "Foremost VI."—The Penarth Pontoon Slipway and Ship Repairing Co., Ltd., Cardiff; (*f*) overhaul of ss. "Sir Walter Raleigh"—The Bickle Engineering Company, Plymouth; (*g*) overhaul of steam hopper barge "Sir Ernest Palmer," tug "Wolfhound," and dumb hopper barge "Redsand"—J. B. Hunt and Co., Ltd., West Side, North Alexandra Dock, Newport; (*h*) provision of reinforced concrete floor, new shed, No. 1 ballast wharf, South Dock, Swansea—Davies, Middleton and Davies, Ltd., 17, St. Andrew's-crescent, Cardiff; (*i*) re-sheeting of storage shed No. 61, Swansea, Prince of Wales' Dock—Archibald D. Dawnay and Sons, Ltd., Steel Works-road, Battersea, S.W. 11; (*j*) re-sheeting of storage shed No. 56, Swansea, Prince of Wales' Dock—The Wolverhampton Corrugated Iron Company, Mersey Ironworks, Ellesmere Port; (*k*) supply and erection of hydraulic operating machinery for sluices of outer dock gates, Penarth—Sir W. G. Armstrong, Whitworth and Co., Ltd., Elswick Works, Newcastle-on-Tyne; (*l*) provision of electric pumping plant at Donham—Worthington-Simpson, Ltd., Queen's House, Kingsway, W.C. 2; (*m*) provision of one 350-kW synchronous motor generator for Swansea—General Electric Company, Ltd., Magnet House, Kingsway, W.C. 2; (*n*) supply, delivery and erection of three 3-ton overhead travelling electric cranes for Brentford Dock—Clyde Crane and Engineering Company, Ltd., Mossend, Lanarkshire; (*o*) reconstruction of Appleford Viaduct, Culham—A. Jackaman and Son, Ltd., 13, Mackenzie-street, Slough; (*p*) enclosing of open platform, new mileage yard, Paddington—W. Walkerdine, Ltd., 115a, Walmer-road, W. 10; (*q*) erection of transit shed for motor traffic at Brentford Dock—E. C. and J. Keay (1926), Ltd., Princes Chambers, Corporation-street, Birmingham; (*r*) construction and erecting of steel work for new south signal box, Cardiff, Queen-street—John Lysaght, Ltd., St. Vincent's Ironworks, Bristol; (*s*) repairs to track of travelling electric crane, South Lambeth Goods Station—Wm. Brown and Son (Builders), Ltd., 195, Uxbridge-road, W. 12; (*t*) renovation and improvement of office and livestock accommodation at Adelphi Wharf, Waterford—Messrs. H. and A. Hamilton, Thomas-street, Waterford; (*u*) renovation and decoration of offices at 9, Bond-street, St. Heliers, Jersey—Mr. Chas. Le Quesne, Union-street, Jersey.

INDUSTRIAL ELECTRIC HEATING EXHIBITION IN EAST LONDON.—An exhibition and a series of demonstrations of industrial electric heating apparatus, which have been organised by the British Electrical Development Association, will take place at the new electricity works, Metropolitan Borough of Poplar, Glaucus-street, Bromley-by-Bow, E. 3, from Monday, January 30th, to February 4th, 1928—2 p.m. to 9 p.m. daily. The exhibition will represent the most modern applications of electric heat to industrial processes, and several of the furnaces, welders, ovens and other appliances exhibited will be in operation.

THE MACHINE TOOL EXHIBITION.—We are informed that the Machine Tool Exhibition in September next has been duly certified by the Board of Trade as an Industrial Exhibition for the purpose of the Patents and Designs Acts of 1907 and 1919. It is necessary that exhibitors desirous of availing themselves of the protection afforded by the Acts should, before exhibiting their inventions or designs or articles to which designs are applied, or publishing a description of such designs, give the Comptroller-General of Patents, Designs and Trade Marks, Industrial Property Department, Board of Trade, 25, Southampton-buildings, W.C. 2, the prescribed notice of their intention to do so.